

AD-A231 614

# DECADE OF CHANGE 1990'S



**Armament  
Challenge for  
the 1990's . . .**

*Advanced Planning  
Briefing for Industry*

25-26 September 1990

U.S. Army Armament Research  
Development and Engineering  
Center  
Picatinny Arsenal, N.J. 07806-5000

Supported by

American Defense Preparedness Association



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ARDEC ADVANCED PLANNING BRIEFING FOR INDUSTRY  
"DECADE OF CHANGE" - ARMAMENT CHALLENGE FOR  
THE 1990'S

MONDAY, 24 SEPTEMBER 1990

1700 - On Site Registration  
1900 - Sheraton Tara Hotel

TUESDAY, 25 SEPTEMBER 1990

0730 Buses Depart from Sheraton Tara Hotel

0800 Registration - Bldg 1 Conference Center, ARDEC

0845 Administrative Remarks - Elaine Tierney, Advanced Systems  
Concepts Office (ASCO)

0855 Welcoming Remarks - Colonel W. Holmes, Commander US Army  
Armament Research, Development & Engr Center

0900 Keynote Address  
Honorable Donald Atwood, Deputy Secretary of Defense

0930 Tech Base Master Plan - George T. Singley III - Deputy  
Assist Secretary for Research & Technology

1000 Threat-Environment Projection for Fire Support 1990 - 2000 -  
Timothy Carey, ASCO

1025 Coffee Break

1055 Fire Support Modernization Plan - Colonel E.G. Anderson,  
Director for Combat Development-Ft. Sill

1125 Fire Support Armaments Center, Colonel G. James, Commander

1200 Lunch (Officers Club)

1400 Advanced Field Artillery Systems - Theophil Kuriata, PM AFAS

1425 Electric Guns - Thaddeus Gora, FSAC

1450 Insensitive Munitions - Patrick Serao, Armament Engineering  
Directorate (AED)

1520 Fire Control Battlefield Management-Eugene Del Coco-FSAC

1545 Smart Munitions - Bob Reisman, FSAC

1615 Adjourn

1900 Reception (Sheraton Tara Hotel)

ARDEC ADVANCED PLANNING BRIEFING FOR INDUSTRY  
"DECADE OF CHANGE" - ARMAMENT CHALLENGE FOR  
THE 1990's

WEDNESDAY 26 SEPTEMBER 1990

0800 Buses Depart from Sheraton Tara Hotel, Banquet Entrance

0830 Fire Control Armored Systems Modernization (ASM) - Larry Yung, FSAC

0900 Extended Range Munitions - Frank Brody, FSAC

0930 Command & Control Mines - Wayne Ahlers, FSAC

1000 Coffee Break

1020 Warhead Developments - James Pearson, Armament Engineering Directorate

1050 Special Forces Requirements - Major Phillip Hamilton, McDill AFB, FL

1115 Special Forces Initiatives - Captain Gilbert Z. Brown, Advanced Systems Concepts Office

1135 1991 APBI Preview - Renata Price, Close Combat Armaments Center

1200 Summary - Colonel W. R. Holmes, Commander, U.S. Army Armament Research, Development and Engineering Center

1230 Lunch (Officers Club)

1400 Buses Depart for Sheraton Tara Hotel



The information provided is accurate as of the time of publication, and may be subject to change.

THE OVERALL CLASSIFICATION

OF THIS PUBLICATION IS

UNCLASSIFIED.



Advanced Planning Briefing for Industry

# Army Technology Base Master Plan

Technology → Bridge to the Future

GEORGE T. SINGLEY III

DEPUTY ASSISTANT SECRETARY FOR  
RESEARCH AND TECHNOLOGY  
OASA(RDA)

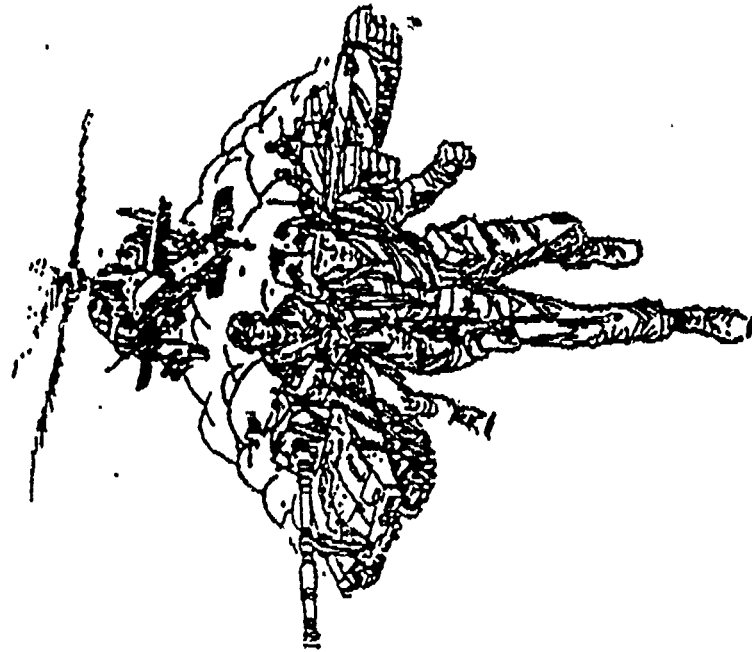
# A NEW REALITY

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## TRENDS:

- ↓ European War
- ↑ Low Intensity Conflict Special Operations
- ↑ Third World (More Lethal!)
- ↑ Role in Drug Wars and Treaty Compliance Monitoring
- ↑ Global Economic/Technological Competition
- ↓ U.S. Defense Industry Base and Long Term R&D
- ↓ Supply of Quality U.S. Citizen Scientists, Engineers, and Technicians
- ↓ Defense Budget

**MORE VERSATILE, DEPLOYABLE, AND HIGHER TECH  
FORCE**



*"My vision is of an Army  
that is trained and ready,  
today and tomorrow, to carry  
out its role as a strategic  
force anywhere in the world,  
anytime."*

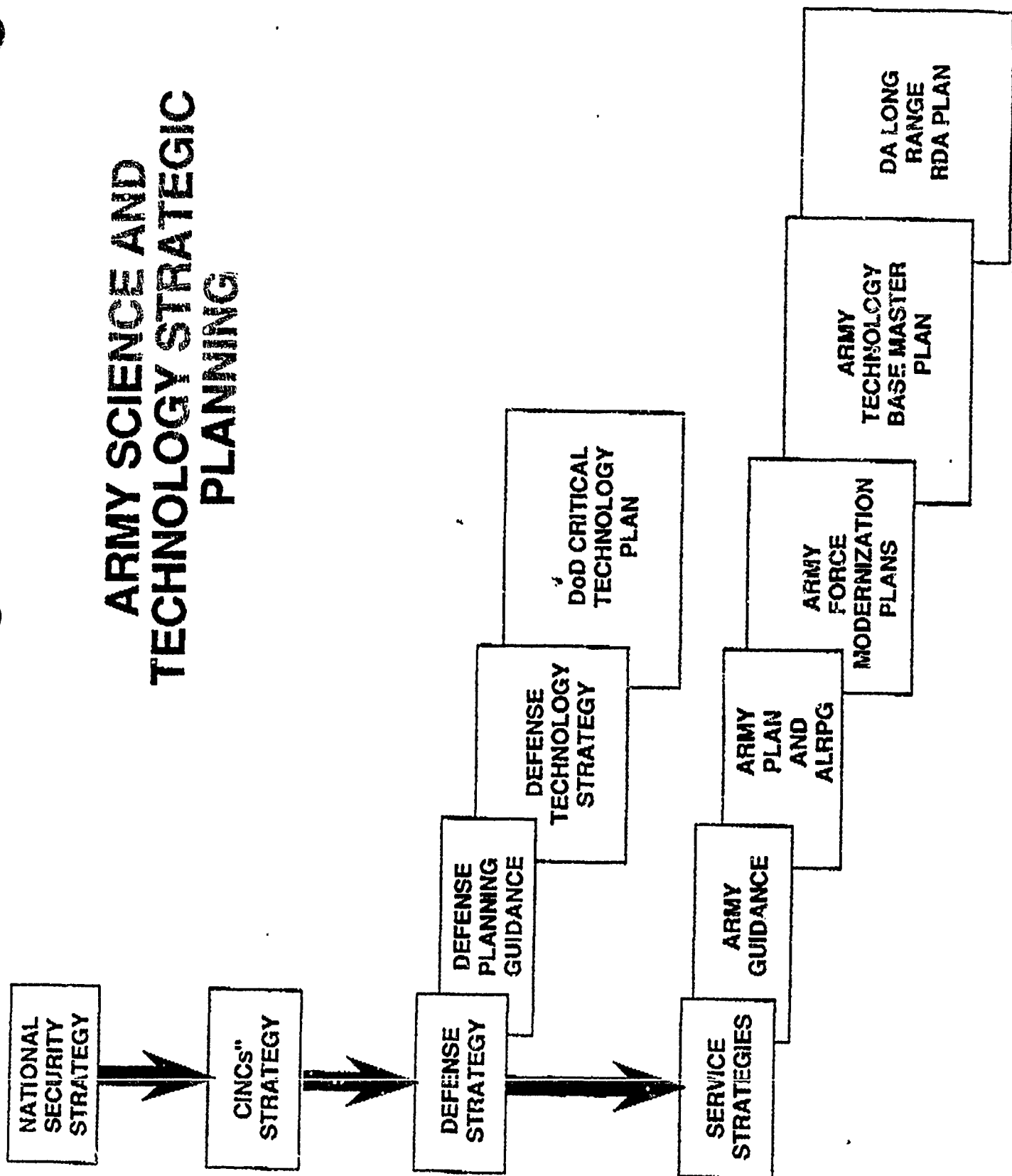
General Carl E. Vuono  
Chief of Staff, U.S. Army

## **Major RDA Issues**

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- **FORGE AN ACQUISITION STRATEGY IN A CHANGING WORLD**
- **STRENGTHEN REQUIREMENTS PROCESS AND BUTTRESS TECHNOLOGY WHILE BUDGETS SHRINK:**
- **MAINTAIN WEAPON SYSTEM QUALITY**
- **ENHANCE FORCE PROJECTION TO MEET NATIONAL INTERESTS, COMMITMENTS AND STRATEGY**
- **DEVELOP "LEAP AHEAD" TECHNOLOGIES TO IMPROVE LETHALITY, VERSATILITY AND DEPLOYABILITY**

# ARMY SCIENCE AND TECHNOLOGY STRATEGIC PLANNING



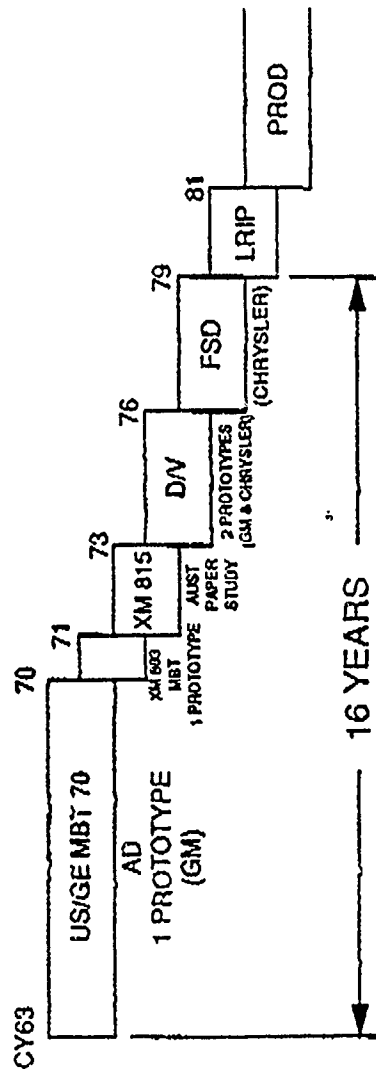
# **Army Technology Base Master Plan**

- Resource Constrained
- Linked to Army Force Mod Plans
- Balance between Push (Key Emerging Technologies) and Pull (Army Force Mod Plans)
- Articulates Tech Base Investment Strategy
- Provides top-down guidance in S&T Objectives (STOs)
- Leverage's other people's money

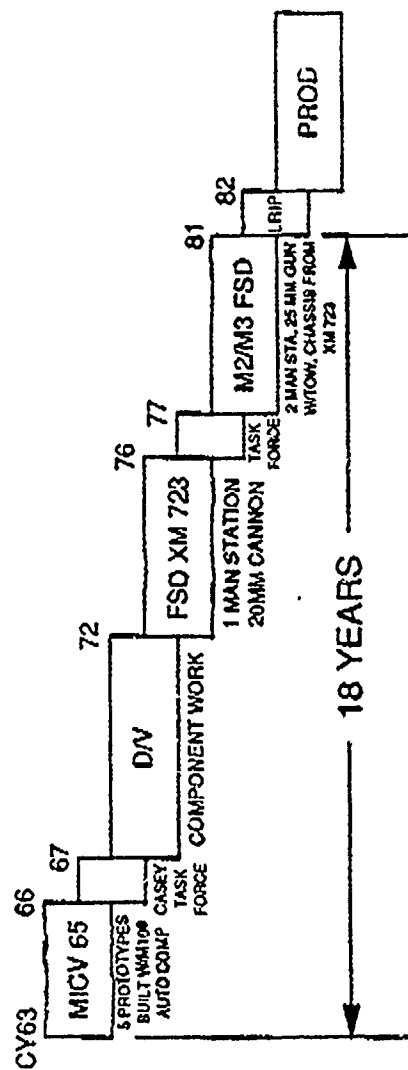


# ASM History of M1 & BFVS Development

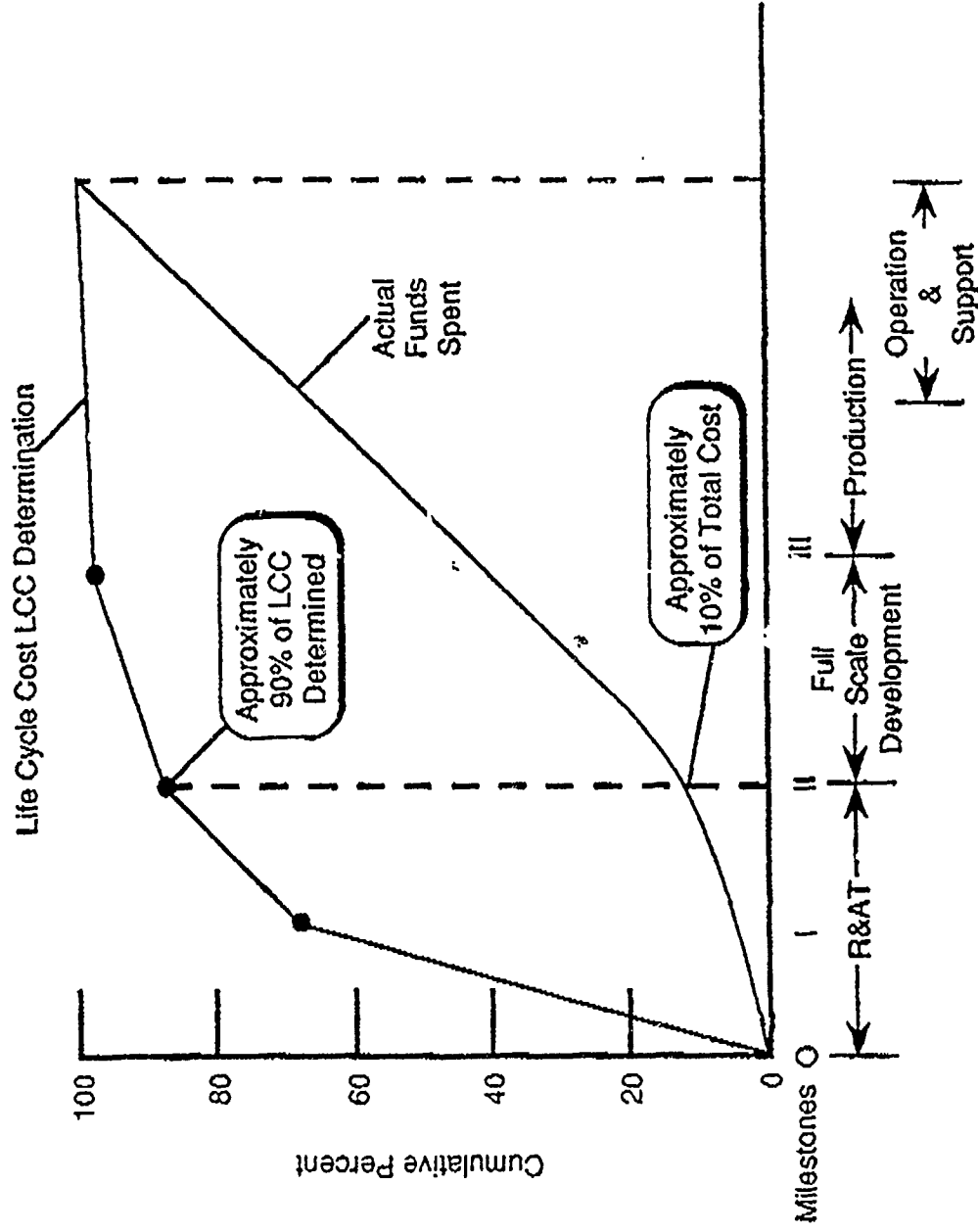
## TANK DEV LEADING TO M1



## MICV/BFVS DEVELOPMENT LEADING TO M2/M3

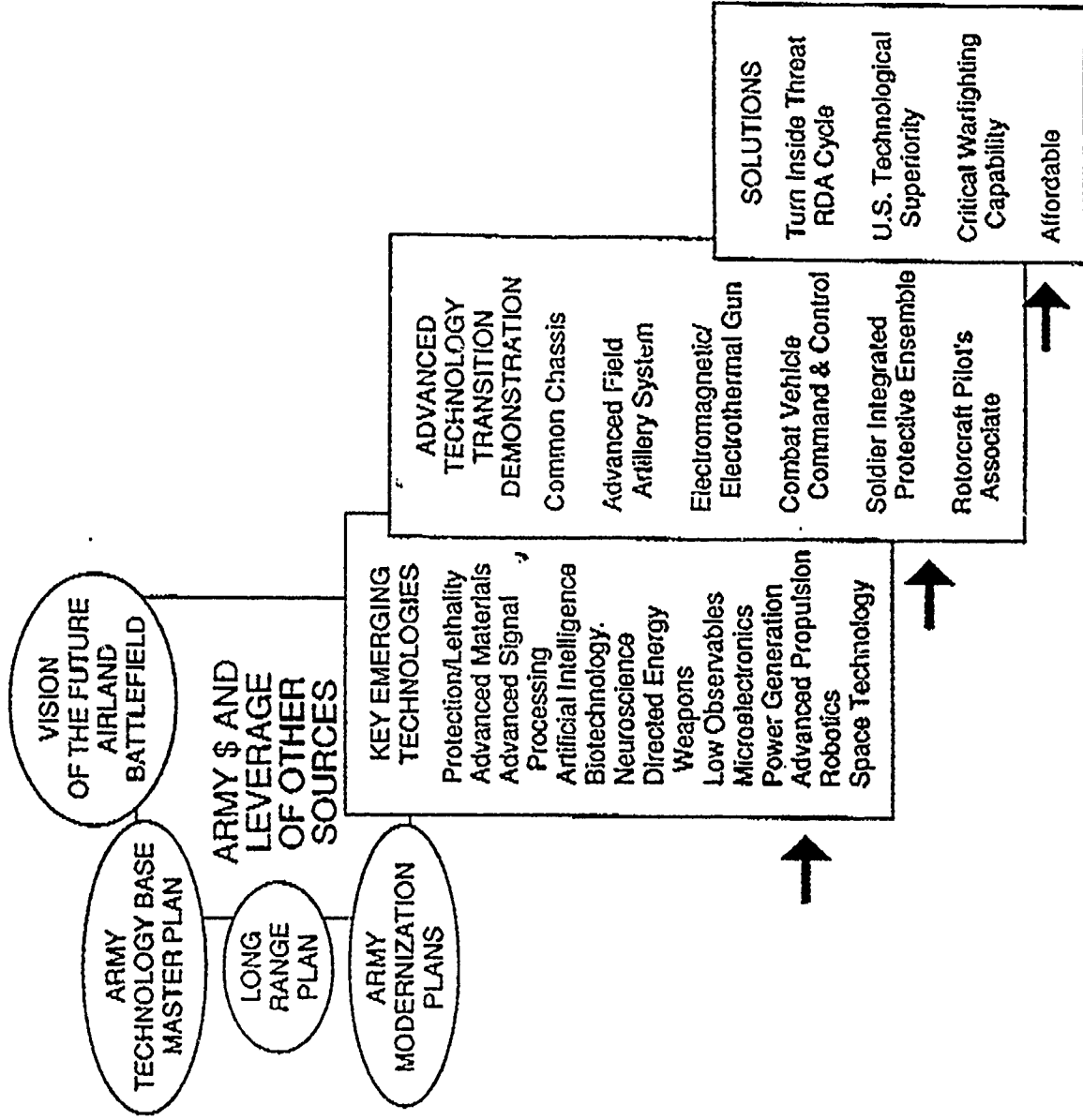


# ASM ➡ Typical Weapon System Life Cycle Cost Overview



Bottom Line: Do Pre-Milestone II concept exploration/definition right since for 10% of the system LCC, 90% or the decisions shaping LCC will be made by then.

# ARMY TECHNOLOGY BASE STRATEGIC PLANNING INITIATIVE



## ADVANCED TECHNOLOGY TRANSITION DEMONSTRATIONS (ATTDs)

### CRITERIA

- o RISK REDUCING "PROOF OF PRINCIPLE" DEMONSTRATIONS CONDUCTED IN AN OPERATIONAL ENVIRONMENT RATHER THAN A LABORATORY ENVIRONMENT
- o POTENTIAL FOR ENHANCED MILITARY OPERATIONAL CAPABILITY OR COST EFFECTIVENESS
- o DURATION OF THREE YEARS (TYPICALLY)
- o A TRANSITION PLAN IN PLACE (APPLICATIONS AND WINDOWS)
- o ACTIVE PARTICIPATION BY THE USER COMMUNITY (PROPONENT)
- o PARTICIPATION BY THE DEVELOPER (SERVE AS PROJECT MANAGER)

# Key Emerging Technologies Support for Modernization Plans

## TECHNOLOGY → BRIDGE TO THE FUTURE

**LEGEND:** ○ Major Impact  
● Highest Impact

### MODERNIZATION PLANS

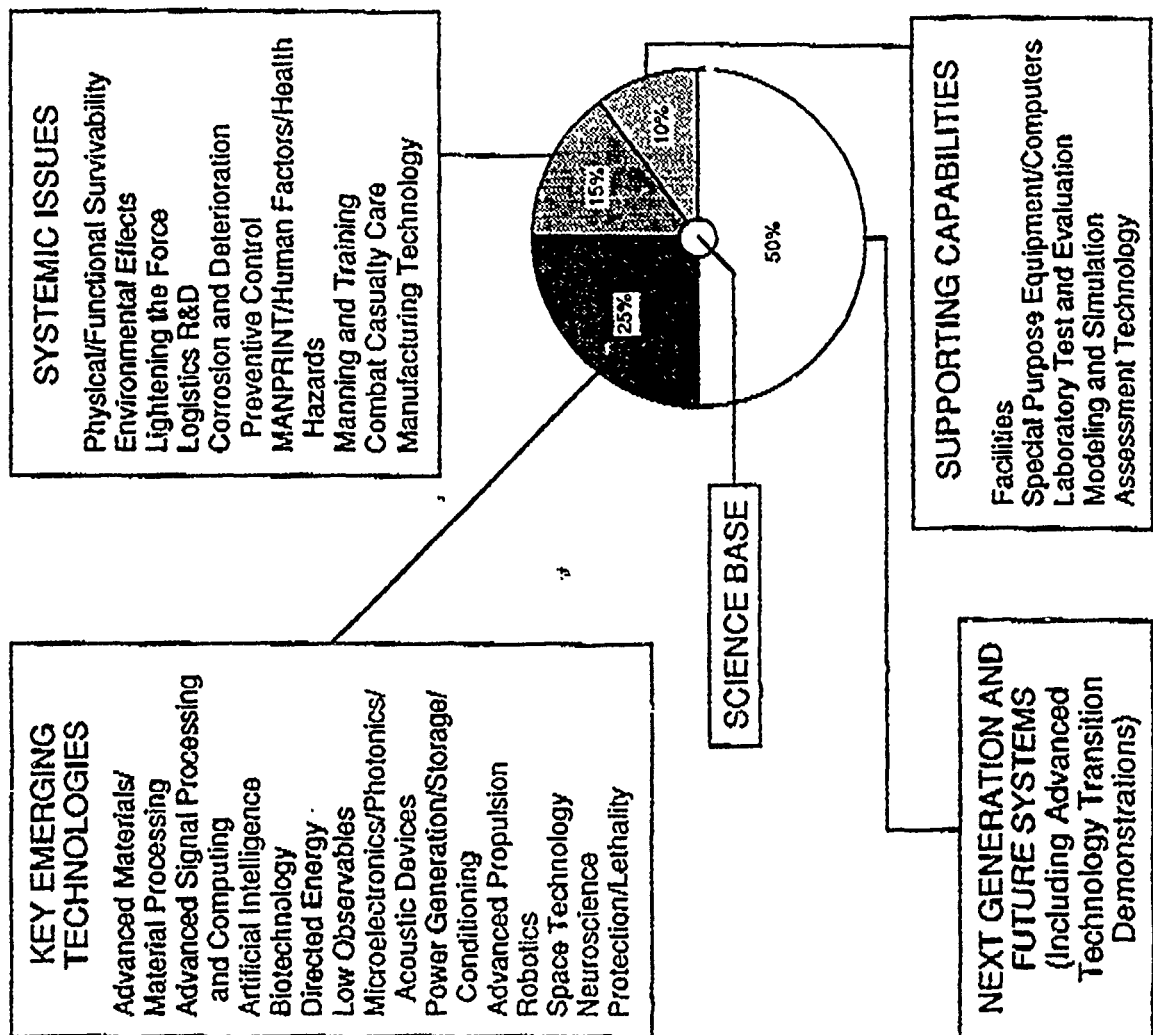
KEY EMERGING TECHNOLOGIES	ARMOR/ANTI-ARMOR	ARMORED SYSTEMS	FIRE SUPPORT	DEEP ATTACK	AIR DEFENSE	AVIATION	LIGHT FORCES	C3/IEW
Advanced Propulsion		●	○			●		
Adv Signal Processing and Sensors		○	○	○	○	○	○	●
Artificial Intelligence		○	○	○	○	○	○	●
Biotechnology							●	
Directed Energy Warfare	○	●			●	○	○	
Low Observables		○	○	○	●	●	○	○
Micro-Electronics/Photonics/Acoustic Devices		○	○	○	○	○	○	●
Neuroscience							●	○
Power Generation/Storage/Conditioning	○	●	○		○		○	○
Protection/Lethality	●	○	○	○	○	○	○	
Robotics		○	○			○	●	
Space Technology			○	○		○	○	●
Advanced Materials	●	○	○	○	○	○	○	●

# New Revolutionary Capabilities

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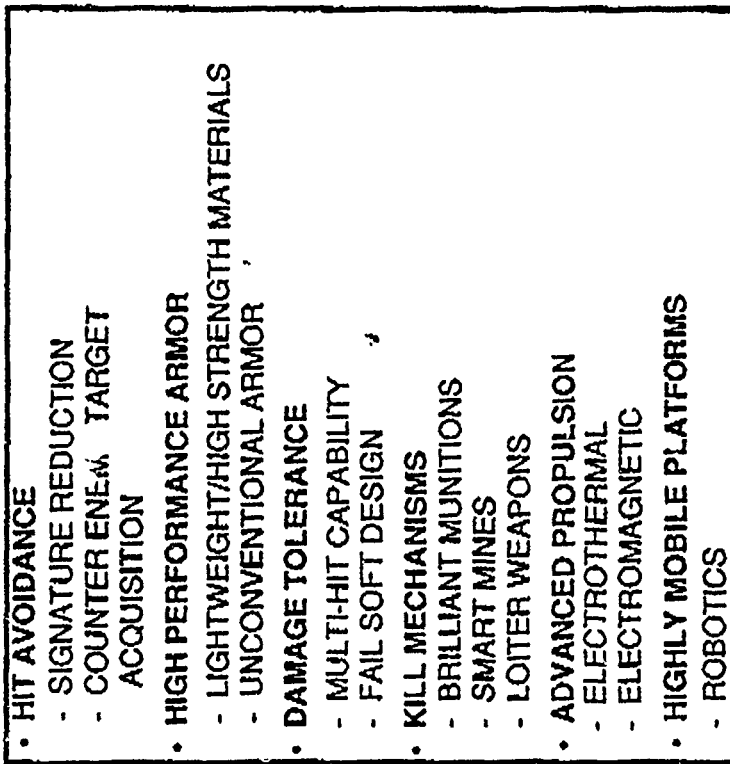
- Advanced Simulator Networks (Concept Formulation, Distributed Wargaming Leader Development & Training)
- AI/Data Fusion for AirLand Battle Information Management
- Automatic Target Recognition via AI, Sensor/Data Fusion
- Composite Ground/Air Vehicles (w/smart skins & low observables)
- "Cray in a Can"
- Electric Vehicles
- Hypervelocity Gun Propulsion & Missiles
- Smart Weapons & Munitions
- Tactical Exploitation of Space
- Unmanned Aerial Vehicles/Unmanned Ground Vehicles (UAV/UGV)

# TECHNOLOGY BASE RESOURCE DISTRIBUTION



# PROTECTION/LETHALITY

- JOINT ARMY/DARPA/USMC  
A3 PROGRAM



- COMPOSITE  
HULL ATTD
- ADVANCED  
ARMOR

- MAJOR INCREASE IN \$
- EM FOR TANK
- ETC FOR TANK
- ETC FOR ARTILLERY
- TIMELY ATTDs
- ARMY, DARPA, DNA,  
BTI & USN COOP

- FOCUSED ARMY/USMC  
ROBOTICS PROGRAM



# ELECTRIC GUN SCHEDULE

SYSTEM	GUN PROP	89	90	91	92	93	94	95	96	97	98	99	00
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TANK	EM/ETC	<div><div>PROGRAM SUPPORT</div></div>											
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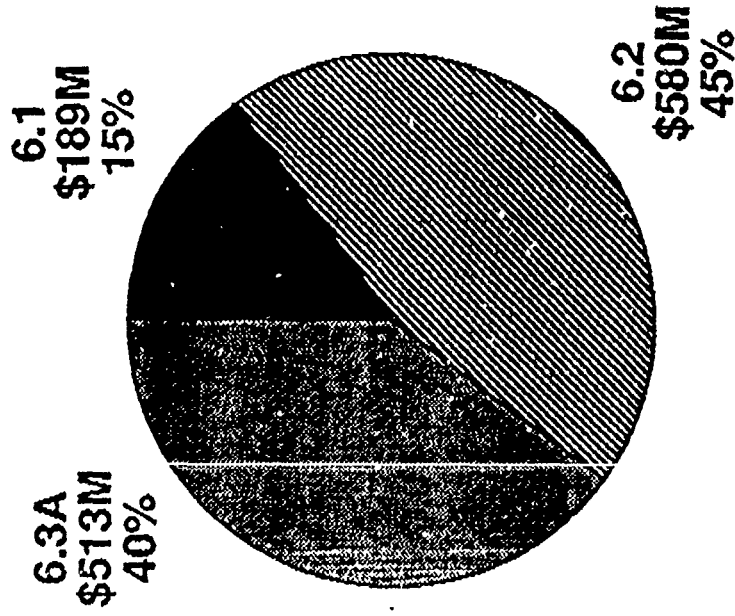
# ARMY TECHNOLOGY BASE FUNDING (\$M)

	<u>FY89</u>	<u>FY90</u>	<u>FY91</u>
BASIC RESEARCH (6.1)	171	182 <sup>①</sup>	189 <sup>①</sup>
EXPLORATORY DEVELOPMENT (6.2)	571	548	580
6.1 + 6.2 SUBTOTAL	742	730	769
NON-SYSTEM ADVANCED DEVELOPMENT (6.3A)	415	502	485
TOTAL	1157	1232	1254

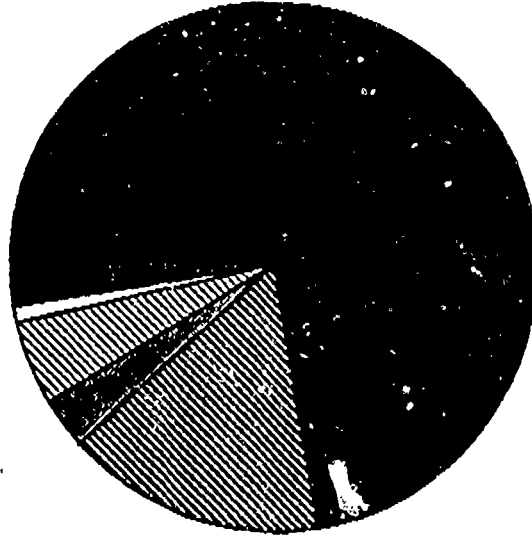
## NOTES:

1. Less DoD University Research Initiative Funds (\$22M in FY90&91)
2. Reference: FY91 Amended Budget Submission, January 1990

# ARMY FY91 TECHNOLOGY BASE FUNDING DISTRIBUTION



By Funding Category



By Command

## **FIFTY YEARS OF ARMY TECHNOLOGY BASE ACCOMPLISHMENTS 1940-1990**

---

- 1980 - 90 Anticonvulsant therapy for soman nerve agent  
Nobel Prizes awarded in Physics: Bloembergen - Non-linear optics;  
Schawlow - Lasers
- 1970 - 80 Reverse osmosis water purification fielded  
First generation thermal imager fielded
- 1960 - 70 Low altitude parachute extraction system developed  
Laser range finder originates
- 1950 - 60 Photolithographic process for printed circuit boards developed  
M105/M108 self-propelled howitzers developed
- 1940 - 50 ENIAC, first digital computer, patented by BRL  
Atomic bomb fielded

# Army Technology Base

TECHNOLOGY TO DETER AND DEFEAT

KEY EMERGING TECHNOLOGIES FOR TECHNOLOGY SUPERIORITY

AVOID TECHNOLOGICAL SURPRISE

MODERNIZATION FOR A MORE LETHAL, DEPLOYABLE, VERSATILE,  
AND SUSTAINABLE FUTURE ARMY

ARMY TECHNOLOGY BASE MASTER PLAN IS OUR ROAD MAP

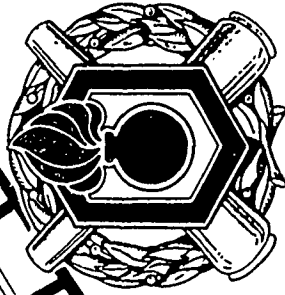
REVOLUTIONARY WARFIGHTING CAPABILITIES:

- Electric Guns
- Smart Weapons
- Deep Attack
- Automatic Target Recognition
- Signature Control
- AirLand Battle Management

**OUR BRIDGE TO THE  
FUTURE ARMY**

**Advanced  
Planning for  
Briefing for  
Industry**

**DECADE OF  
CHANGE  
90'S**



**Armament Challenges for  
the 1990's . . .**

***Threat Environment  
Projection for  
Fire Support***

**1990-2000**

**PRESENTED BY**

**TIMOTHY CAREY**

**Advanced Systems Concepts Office  
724-6308**

# ***Threat Environment***

---

## ***Projection***

Forces capable of posing the  
greatest challenge to U.S. units  
will be those fielded by the  
Soviet Union

**HOWEVER**

Direct conflict between the  
United States & the USSR is judged  
to be the least likely conflict  
in the years ahead

# ***Combat Environments***

---

---

- Soviet/European Battlefield
- Regional Battlefields - High Intensity
- Regional Areas - Low Intensity



# ***Soviet/European Battlefield***

- Soviet Ground Forces Smaller In Terms Of Overall Numbers, But More Modern
- Ground Forces Will Be Capable Of Concentrating Effective Fires To A Greater Depth
- Improved Capability For C3I Incorporating Data Links, Automation, And ECCM
- Conventional Warheads With Improved Accuracies And Enhanced Explosives

# ***Reduction of Forces***

- Force Size Is Expected To Decline Significantly
- Post-CFE Soviets Are Expected To Retain A Limited Offensive Capability As A Follow-up From A Defensive Posture

# ***Soviet Force Development***

## ***Guidelines***

---

- Adoption of a Defensive Doctrine
- Need to Reduce Western Perceptions of the WP Threat
- Arms Control Agreements

# ***Derived Benefits of Changed Threat Perception***

- Significant Reductions in
  - SDI
  - Commodity Control Restrictions (COCOM)
  - Western Military Modernization
  - Western Mobilization/Readiness Capabilities
- Pressure by U.S. Congress for Further Reductions in U.S. Military Spending

# ***Military Dimension***

- Deemphasized but not Forgotten
  - Only Claim to Superpower Status
- Military Mission in Flux
  - External Role Discredited & Discarded
- Force Structure Subject to Competing Demands
- Crisis of Confidence
  - Professional Competence Under Attack

# ***Soviet Force Employment***

- Soviet Forces will be Prepared to Defend Soviet Territory
- Forward Deployed Soviet Forces will Assume a Defensive Posture
- Soviet Forces will Maintain a Level of Offensive Capability Sufficient to Conduct Counterattacks

# ***General Technology***

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## ***Trend***

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- Soviets will Maintain a Strong National Commitment to Improve S&T Base
- Pursue a Force Modernization Program
- Seek Stealth and Counterstealth Tech
- Newer Systems are Expected to be Automated and Require Fewer People
- Emphasize Modifications to Operational Weapon Systems

# **== Warsaw Pact ==**

## **GENERAL PURPOSE FORCES**

VA 490B-12RTB



# ***Regional Challenges***

- **Instability, Division, and Economic Duress will Pose Great Challenges**
- **Many Nations will be Equipped with New Modernized Weapons**

# ***High Intensity Regional Battlefield***

- Forces will be Heavily Equipped
- Weapon Systems Mix will be Unique to Each Nation
- Great Challenge to Development of Electronic Countermeasures
- Chemical-Biological-Radiological Munitions

# ***Middle East/Persian Gulf***

- Potential Use of Chemical, Biological, and Nuclear Weapons
- Use of Ballistic Missiles

# ***Lower Intensity Conflicts***

- Weapons in this Arena will Range from Obsolete to Modern
- Limited Capability for Sustainability
- U.S. Access to Forward Basing May be Denied

# ***Northeast Asia***

- China
  - New Leaders, Economic Reform
- Japan
  - Growth Superpower
- North Korea
  - Problems After Succession
- South Korea
  - Continued Economic Growth

# ***South Asia***

- Philippines
  - Bumpy Road Ahead
- Cambodia
  - Instability Persists
- Drug Problem Recognized as a Regional Threat

# **Latin America**

- Castro will be Gone
- Two Big, Endemic Challenges Remain
  - Debt
  - Drugs
- Continued Insurgency
  - Columbia, El Salvador, Peru

# **Conclusion**

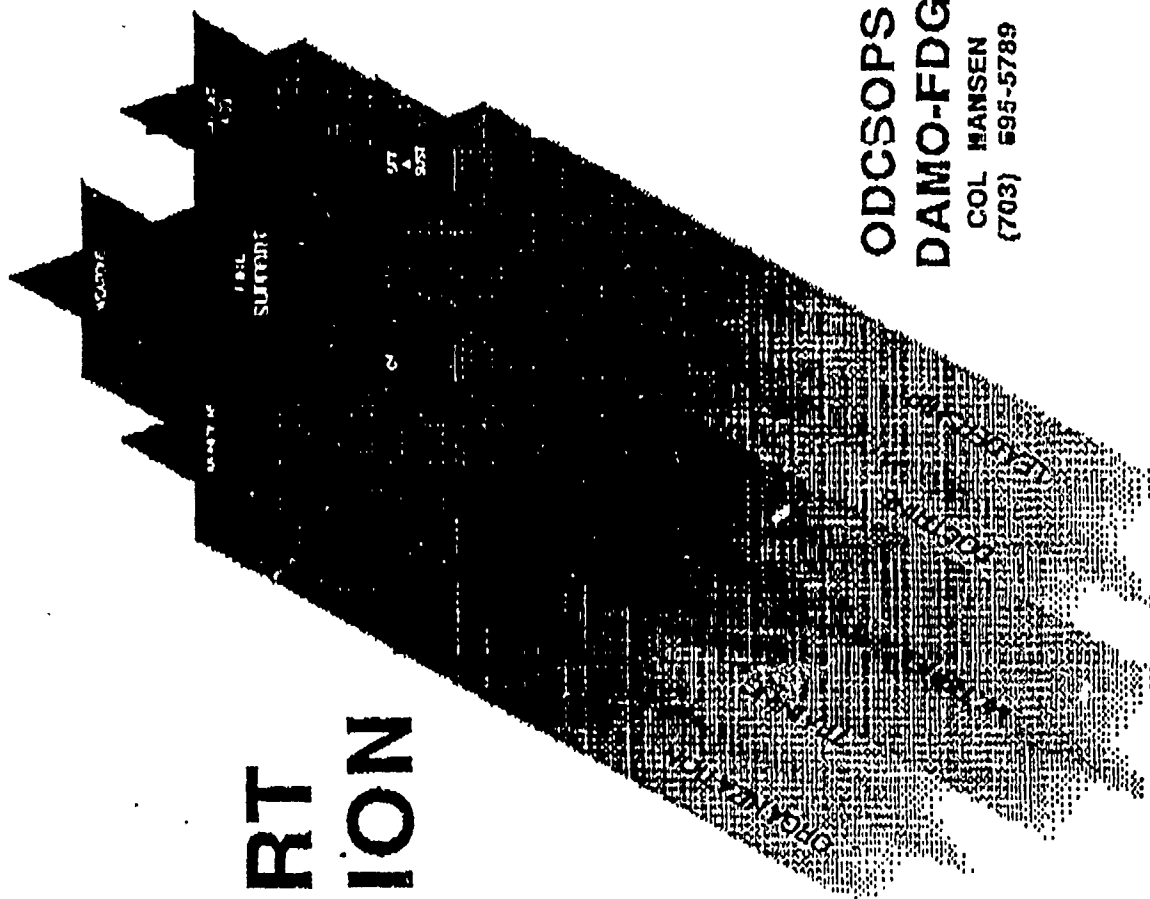
**Regional Hostilities, Ranging in Scope from Conventional Main Force Actions in the Mideast/Persian Gulf to Counter-Guerrilla Operations in Central America Have the Greatest Potential for Future American Involvement**



This Briefing was prepared by Colonel Jerry Hansen

and presented by Colonel E.G. Anderson

# FIRE SUPPORT MODERNIZATION PLAN



ODCSOPS  
DAMO-FDG  
COL HANSEN  
(703) 595-5789

## FIRE SUPPORT MASTER PLAN

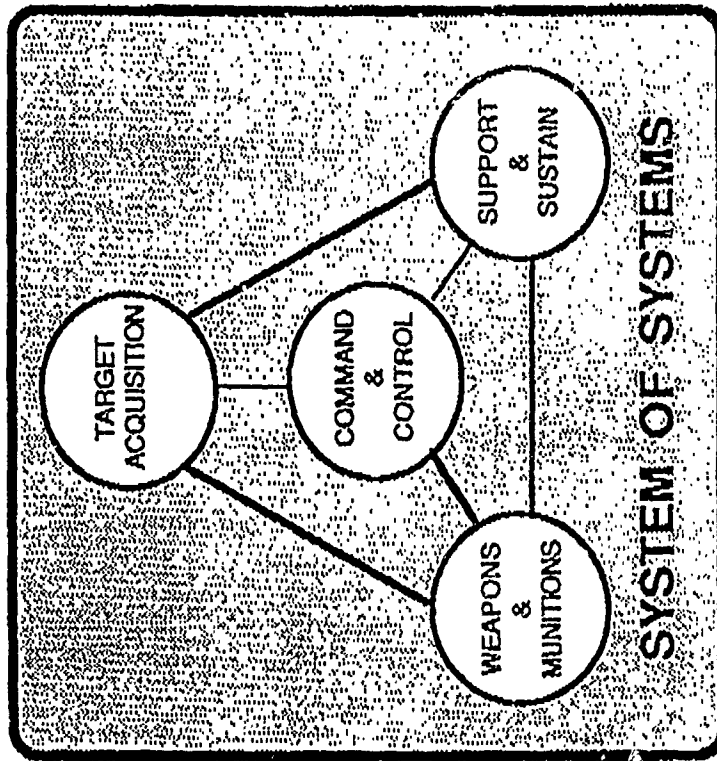
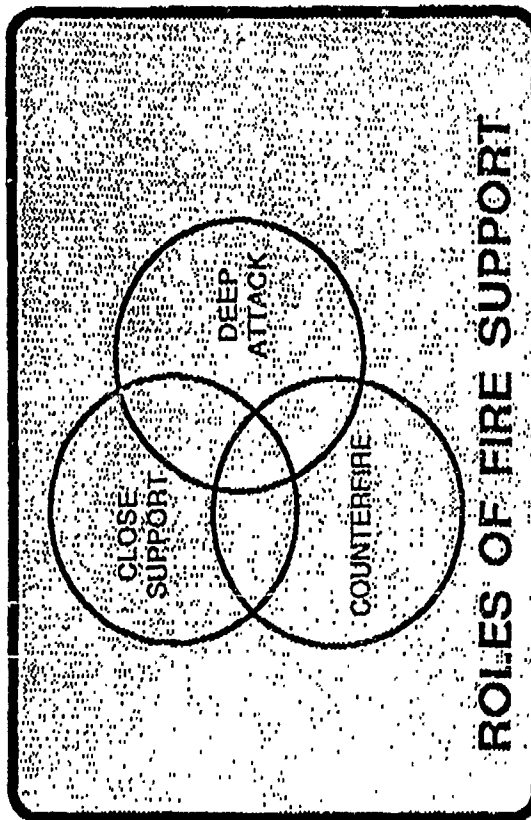
- ENDORSE AS STRATEGY FOR FIRE SUPPORT MODERNIZATION.
- APPROVE 8-INCH TRANSITION FORCE DESIGN.
- ARSTAF ASSESS AFFORDABILITY AND PREPARE CONSTRAINED IMPLEMENTING PLAN (FS MOD PLAN) - UPDATE ANNUALLY WITH THE BUDGET.
  - .. COUNTERFIRE: ENHANCEMENT BASED UPON FIREFINDER IMPROVEMENT; SADARM ACCELERATION; INCREASED MLRS PROCUREMENT; AND AFAIDS FIELDING.
  - .. CLOSE SUPPORT: ENHANCEMENTS BASED UPON ACCELERATED HIP PROCUREMENT AND DEVELOPMENT OF AFAS/FARV; DEVELOPMENT OF TGW; AND DEVELOPMENT OF FSCOLS AND UAV.
  - .. DEEP ATTACK: ENHANCEMENT BASED UPON ATACMS BLK I AND II; SUSTAINED FUNDING FOR GRCS AND J-STARS; AND DEVELOPMENT AND PROCUREMENT OF GLTR AND FOTL.
- SUPPORT FOCUS OF TECH BASE ON FIRE SUPPORT ENHANCEMENTS.
- WORK FOR ADDITIONAL TOA TO IMPLEMENT DSB/MASTER PLAN RECOMMENDATIONS.

CSA, SEP 88

DAMO-FDG

## FIRE SUPPORT MODERNIZATION PLAN

- STRATEGIC PLAN FOR FIRE SUPPORT MODERNIZATION
- FISCALLY CONSTRAINED NEAR AND LONG TERM PLAN
- IMPROVES WARFIGHTING CAPABILITY OF FIRE SUPPORT FOR:
  - CLOSE SUPPORT
  - COUNTERFIRE
  - DEEP ATTACK



- INTEGRATES FIRE SUPPORT REQUIREMENTS WITH OTHER ELEVEN ARMY MODERNIZATION PLANS.

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## EXTRA - ARMY GUIDANCE FIRE SUPPORT

### DEFENSE SCIENCE BOARD - SEP 88

- ACCELERATE MLRS FIELDING AND ROCKET PRODUCTION.
- ACCELERATE HIP, COMPLETE FIELDING BY FY94; BEGIN AFAS DEVELOPMENT.
- ACCELERATE DEVELOPMENT AND FIELDING OF SADARM (155 & MLRS).
- FIELD ATACMS AND OTHER DEEP BATTLE SYSTEMS.
- FIX FIREFINDER.

### USD TAFT - OCT 89      OSD LAND WARFARE - OCT 89

- ADDRESS DSB RECOMMENDATIONS IN POM 92-97.

### USD(A) BETTI - NOV 89

- TACIT RAINBOW ADM - FUND PROGRAM TO REVISED BASELINE.

### CONGRESS - NOV 89      CONGRESS - AUG 90

- NEW ARTILLERY SYSTEM WILL HAVE ONE OF THE HIGHEST PRIORITIES IN ASM.
- KILLED APM.

### OSD DEFENSE GUIDANCE (DRAFT) - NOV 89

- PROTECT DEEP FIRES.
  - ATACMS.      - TACIT RAINBOW.      - SPECIAL ACCESS PROGRAMS.

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# RECENT ARMY GUIDANCE FIRE SUPPORT

## QUICK SILVER

- PROTECT FUTURE MODERNIZATION (ASM, LH).
- MID-TERM HIGH PAYOFF SYSTEMS (HHP, MLRS REPLACE 3-IN).
- RESTRUCTURE DEEP FIRES TO CHANGING THREAT.
- REDUCE EMPHASIS ON NUCLEAR (KILL FOTL).

## LIGHT FORCES MODERNIZATION PLAN & PANAMA

- IMPROVE FIRE SUPPORT FOR LIGHT FORCES.
  - M119.
  - 155mm SADARM.
  - FIREFINDER BLK II PIP (HMMWV).
  - LIGHTWEIGHT 155mm HOWITZER / MLRS.

## DESERT SHIELD

- INCREASED EMPHASIS ON CONTINGENCY CORPS.
- INCREASED EMPHASIS ON CONVENTIONAL DEEP BATTLE.
- STRATEGIC MOBILITY.
- ANTI-ARMOR FOR LIGHT FORCES.

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# ARMY MODERNIZATION STRATEGY

## THREAT CHANGING...

- EUROPEAN CONFLICT LESS LIKELY
- 3RD WORLD CONFLICT POTENTIAL INCREASING



## PRINCIPLES...

- LETHALITY & SURVIVABILITY COMPETITIVE WITH THREAT
- STRONG TECHNOLOGY BASE
- ESSENTIAL WARFIGHTING CAPABILITIES (HVV, LT & SOF)
- INVEST IN FUTURE, ACCEPT NEAR TERM RISK

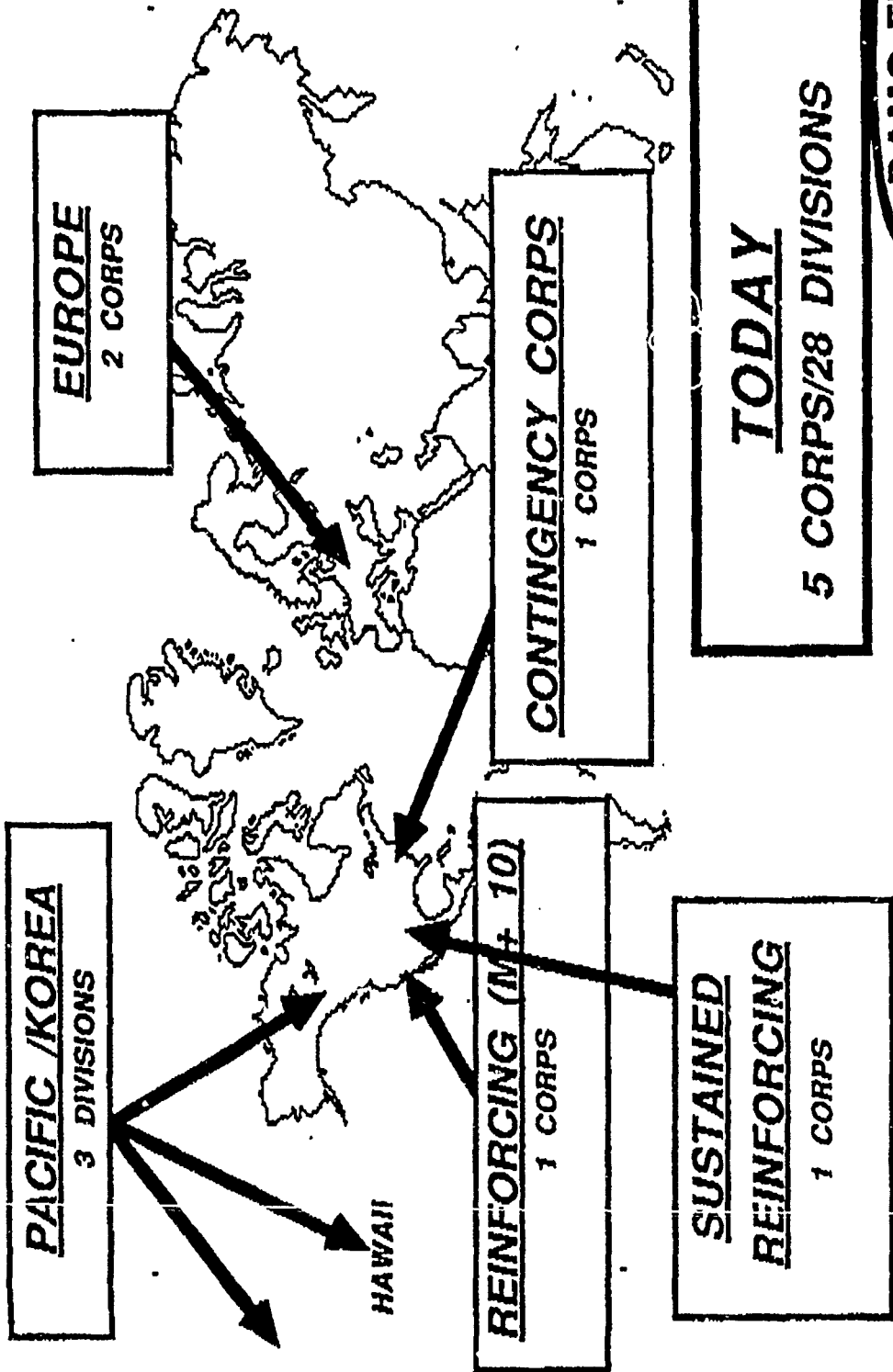
## MODERNIZATION CONSIDERATIONS...

- TECH DATA PACKAGES, DEFER RATE PRODUCTION
- FIELD ONLY TO DETERRENT LEVELS
- LIMITED PIPS & MODS - HIGH ROI ONLY.
- HIGH-LOW MIX & FIELD CAPABILITIES BY FORCE PKGS
- REDUCE REDUNDANCY IN CAPABILITIES
- LEVERAGE COMPETITIVE STRATEGIES

PROTECT THE FUTURE

DAMO-FDG

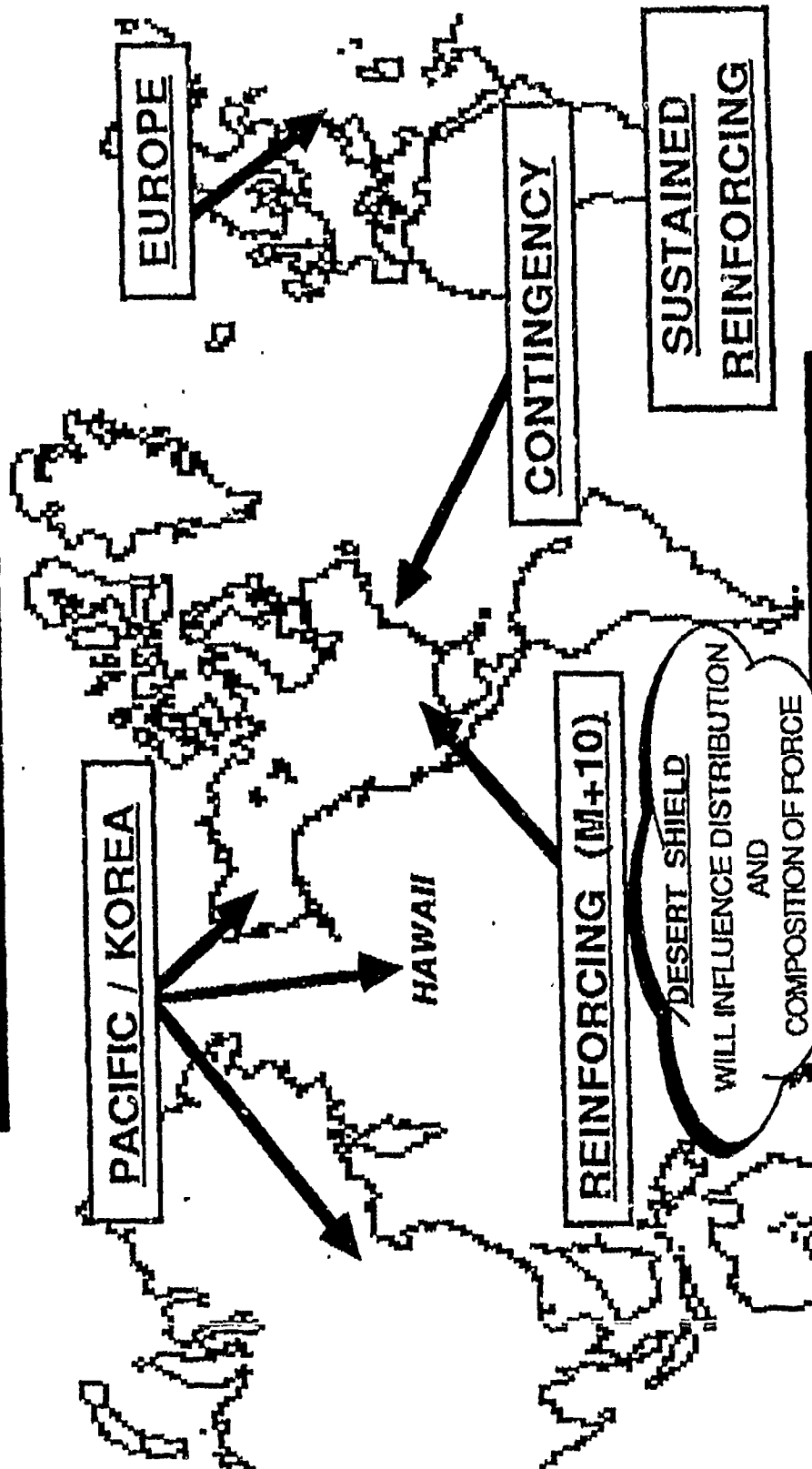
# THE ARMY TODAY



DAMO-FDG



# THE ARMY 1997



1995 ... 4 CORPS - 22 DIVISIONS

# FIRE SUPPORT MODERNIZATION OVERALL PRIORITIES

## KEYS

- DSB SUMMER STUDY 88
- ARTILLERY ACCURACY STUDY
- LEGAL MIX VII
- QUICKSILVER/CFE

• **COMMAND AND CONTROL** { LTACFIRE,  
AFATDS }

• **SUPPORT SYSTEMS** { MET, HYD GEN, FSV,  
MV MGMT, ACCY STUDY }

• **COUNTERFIRE** { MLRS, FF BLK II, IMP FF, SADARM,  
P3I SADARM, REPLACE 8-IN }

• **CLOSE SUPPORT** { HIP, AFAS/FARV, EXT RG CANNON MUN,  
SMART MUN, FIRE SUP VEH/FO DEV }

• **DEEP FIRES** { MLRS DB MOD, ATACMS, ATACMS II,  
EFFECTIVE SUB-MUN, TGT ACQ }

• **LIGHT FORCES** { LT WT 155mm, FO DEV,  
LT WT MLRS, SMART MUN }

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## DISCUSSION

- WHILE THE CURRENT PROGRAM:
  - PROTECTS AFAS/FARV-A
  - DEVELOPS DEEP FIRES CAPABILITY
  - PROVIDES ADEQUATE SHORT/MID TERM MODERNIZATION FOR CLOSE SUPPORT AND COUNTERFIRE
- IT HAS HOLES THAT MUST BE FIXED IN THE FUTURE:
  - FIRE SUPPORT MODERNIZATION FOR LIGHT FORCES
    - LIGHT WEIGHT 155mm HOWITZER ?
    - LIGHT WEIGHT MLRS (HIMARS)?
    - NLOS-AT ?
  - SMART MUNITIONS STRATEGY/PROGRAM
    - 155mm LARGE FOOTPRINT MUNITION ?
    - MLRS - TGW ?
    - ATACMS BLK II?
    - SADARM P3I ?
  - MODERNIZATION OF FIRE SUPPORT COORDINATION
    - REPLACEMENT FOR FIST-V ?
    - IMPROVED CAPABILITY FOR LIGHT FORCES FOS ?

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## CONCLUSIONS

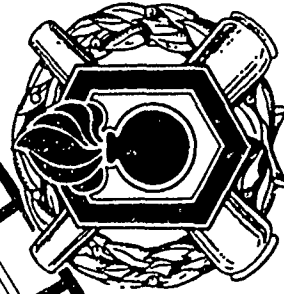
WHILE THE CURRENT FIRE SUPPORT PROGRAM PROTECTS THE LONG TERM MODERNIZATION OF THE HEAVY FORCE, DEVELOPS A CREDIBLE DEEP FIRES PROGRAM, AND PROVIDES LIMITED NEAR TERM MODERNIZATION TO BOTH LIGHT AND HEAVY FORCES ...

IT LEAVES HOLES FOR KEY PORTIONS OF THE FIRE SUPPORT "SYSTEM OF SYSTEMS" THAT MUST BE WORKED IN FUTURE VERSIONS OF THE BUDGET AND FIRE SUPPORT MODERNIZATION PLAN TO INSURE THAT ADEQUATE FIRE SUPPORT WILL BE AVAILABLE ON THE BATTLEFIELD OF THE FUTURE.

DAMO-FDG

**Advanced  
Planning  
Briefing for  
Industry**

**DECADE OF  
CHANGE  
90'S**



**Armament Challenges for  
the 1990's . . .**

## **Advanced Field Artillery System (AFAS)**

**PRESENTED BY  
THEOPHIL A. KURIATA  
PM-AFAS-ARMORED SYSTEMS  
MODERNIZATION  
724-5349**

## Briefing Outline

- What is the Advanced Field Artillery System (AFAS)?
- System Overview
- System Focus
- Program Status
- Program Schedule
- Challenge to Industry
- Summary

## Advanced Field Artillery System

### What is the AFAS?

- Army's next generation 155mm self-propelled howitzer.
- Consists of the AFAS mission module mated to ASM Common Chassis.
- Advanced Technologies Applied:
  - Cannon and Gun Mount
  - Insensitive Propellant
  - Technical and Tactical Fire Control
  - Modular Armor
  - Automated Ammo Handling
  - Increased Survivability/Countermeasures
  - Propellant Ignition System
  - Inductive Fuze Setter
  - External Suspension
  - Advanced Track
  - Total Standard Army VETRONICS Architecture
  - Embedded Tng/Diagnostics/Prognostics/Decision Aids
- Operationally, two-vehicle system (i.e. AFAS and the Future Armored Resupply Vehicle-Ammunition (FARV-A))

## Armored Systems Modernization

# Program Overview

## *AFAS Major Thrusts and Objectives*

- Develop an artillery mission module
- Integrate mission module onto ASM Common Chassis
- Develop a new propulsion system and associated armament
- Develop a multioption fuze for bursting-type projectiles

040501/0000000

## *System Engineering Barriers*

- Ammunition handling integration
- System accuracy at extended ranges
- Vulnerability reduction measures
- Firing Range Optimization
- Diagnostic/Prognostic/Decision Aids

040502/0000000

## *Needed Engineering Efforts*

- Smart Ammunition Handling System
- Innovative vulnerability reduction measures
- Data Acquisition and Analysis techniques to measure, manage, and predict subsequent round interior and exterior ballistics
- Decision Aids to optimize performance
- High reliability mechanical subsystems with graceful degradation

## *Performance Payoffs:*

- Autonomous operational capability
- Ballistic Protection Improvement
- 300% increase in rate-of-fire
- 250% improvement in survivability
- 50% increase in payload
- 33% increase in range
- Automation of resupply/loading ops
- Crew reduction

## *Cost Payoffs:*

- Commonality
- Increased operational effectiveness
- Increased logistics efficiency
- Reduced operation and support costs



## FOCUS

### Lethality

- Rate-of-fire; maximum: 12-16 Rds/Min for 5 Min  
sustained: 3-6 Rds/Min, indefinitely
- Time-on-target: 4 Rounds Simultaneous Impact
- Range: 4 to 6 km minimum  
40 to 50 km maximum
- Muzzle Velocity Repeatability: 0.26% (1 sigma)
- Precision: PErng < 0.28%; PEaz < 0.5 mil
- Responsiveness: Meet or exceed M109A6
- Ammo Payload: 60 to 75 rounds
- Automated Ammo Handling: 12 Rds/Min

## FOCUS

### Survivability

- Armor: Modified Block III Tank
- Configuration: Compartmented crew/weapon/  
storage stations
- Propellant: Insensitive gun propellant
- Autonomous Operations: Technical and Tactical  
(Self plus 1 other howitzer)

### Mobility

- Equal to supporting maneuver force

## FOCUS

### Deployability

- Crew: 3-4; operable by 1
- Transport: Bern Tunnel Profile  
Rail and Ship Envelope

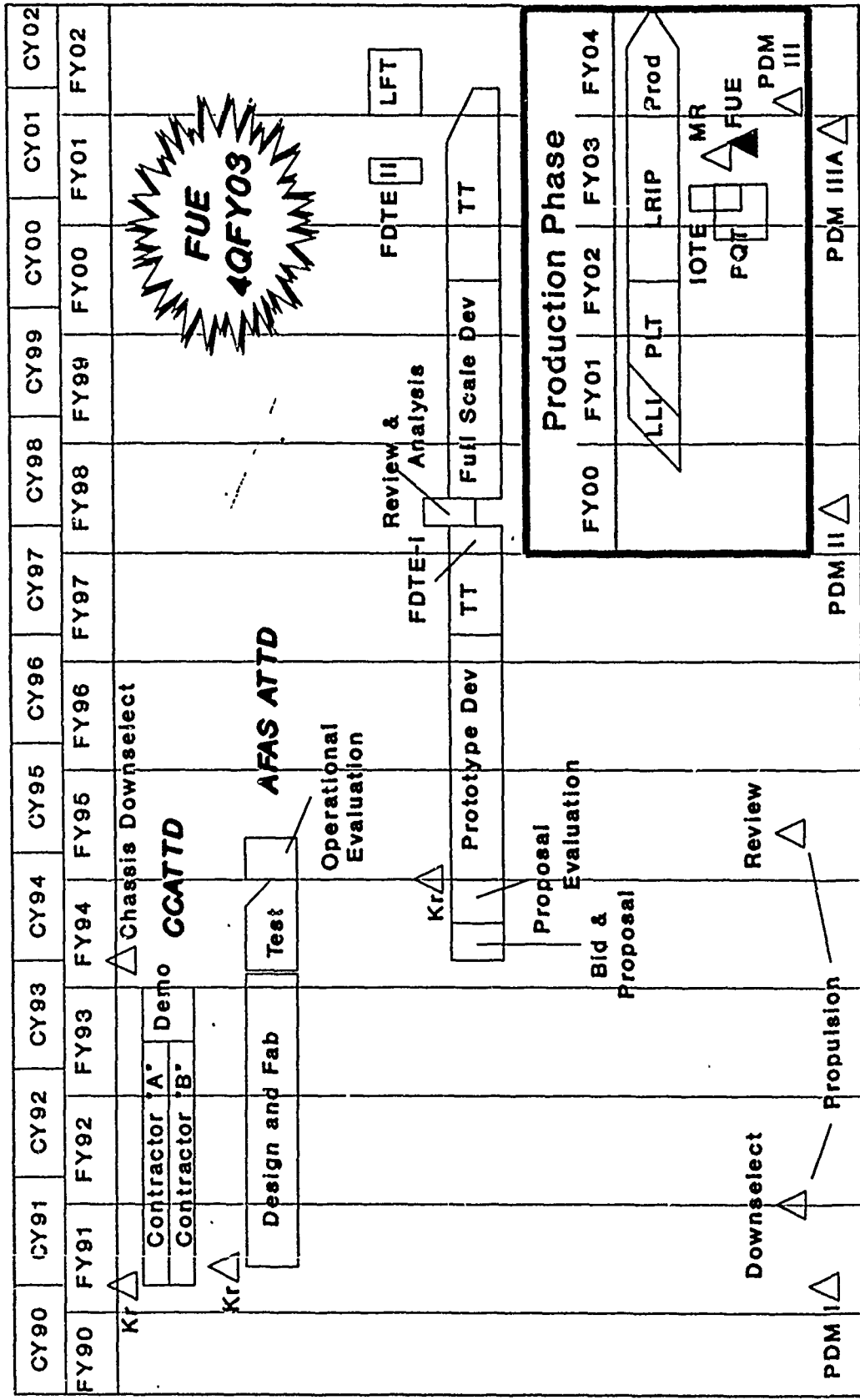
### Sustainability

- Embedded Training: Individual thru Force Levels
- Operations and Support Costs: 30-40% Reduction
- Diagnostics/Prognostics: Extensive capability for ALL mission critical subsystems

## Program Status

- Program in Concept Formulation Phase
- Army System Acquisition Review Council (ASARC) I (Program Start) planned for November 1990
- Both Unicharge and Liquid Propellant Propulsion Systems in Proof-of-Principal Phase (Downselect - September 1991)
- Proposal for AFAS ATTD undergoing Source Selection Board Evaluation (Contract Award - April 1991)
- MOFA transition to PM AFAS Management - October 1991

# Advanced Field Artillery System (AFAS) Program



## Challenge to Industry

- Develop and demonstrate innovative ideas:
  - Weapon Loading Mechanisms
  - Ammunition Transfer and Inventory
  - Ballistic Parameter Management
  - Early Warning Defense System
  - Cost Effective Weight Reduction Measures
  - Interactive Embedded Training
  - Prognostics
- Develop "user friendly" decision aids and reconfiguration advisory functions.
- Reduce Operating and Support Costs of System.

## *Advanced Field Artillery System*

### **Project Summary**

- Program support high from the Congress.
- Program has healthy funding profile.
- Initial Program Elements (ATTD and Propulsion Downselect) are on track.

### **Industry Summary**

- Continued close coordination with Private Industry Technical Base Efforts essential to maximize technology transfer prior to AFAS FSD.
- Industry participation needed to demonstrate maturity of leap-ahead technologies.

## *Armored Systems Modernization*

*Advanced Field Artillery System*

**Acquisition**

**AFAS Prototype Development**

Contract Award: 1QFY94  
39 month Development Program  
Technical Test: Apr-Dec 97 (9 months)  
Operational Test: Jan-Mar 98 (3 months)

**Full Scale Development**

48 month Development Program  
Technical Test: Apr 00 - Dec 01 (20 months)  
Operational Test: Feb - May 01 (4 months)

**Production**

Long Lead Items Procurement: Jul 00 - Jun 01  
First Unit Delivered: July 2002  
First Unit Equipped: 4QFY03

*Armored Systems Modernization*



*Advanced Field Artillery System*

**Acquisition**

**Artillery Propulsion Downselect**

**4QFY91**

**AFAS ATTD**

**Contract Award: March 1991**

**47 month Development Program**

**System Test: January 1994 thru February 1995**

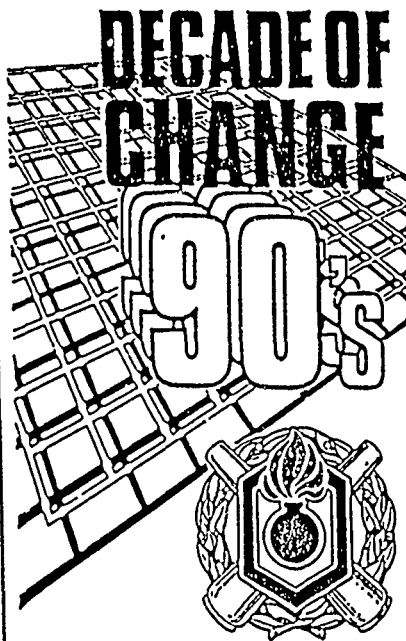
**ASM Heavy Common Chassis**

**Common Chassis Downselect: 1QFY94**

**Common Chassis Available for AFAS Prototype: 1QFY96**

*Armored Systems Modernization*

Advanced  
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Industry



*Armament Challenges for  
== the 1990's ... ==*



COLONEL GERARD JAMES  
FIRE SUPPORT ARMAMENTS CENTER

724-6196

APBI-2

- o WELCOME TO THE 1990 ADVANCED PLANNING BRIEFING FOR INDUSTRY. THIS YEAR'S ARDEC SPONSORS ARE THE FIRE SUPPORT ARMAMENTS CENTER AND THE ADVANCED SYSTEMS CONCEPTS OFFICE.
- o I AM COL JAMES, THE NEW COMMANDER OF FSAC.  
IN THE NEXT 20 OR SO MINUTES, I WILL BRIEFLY ADDRESS THIS YEARS THEME, DESCRIBE FSAC AND INTRODUCE THE DISCUSSIONS WHICH WILL FOLLOW FOR THE REMAINDER OF THE CONFERENCE.

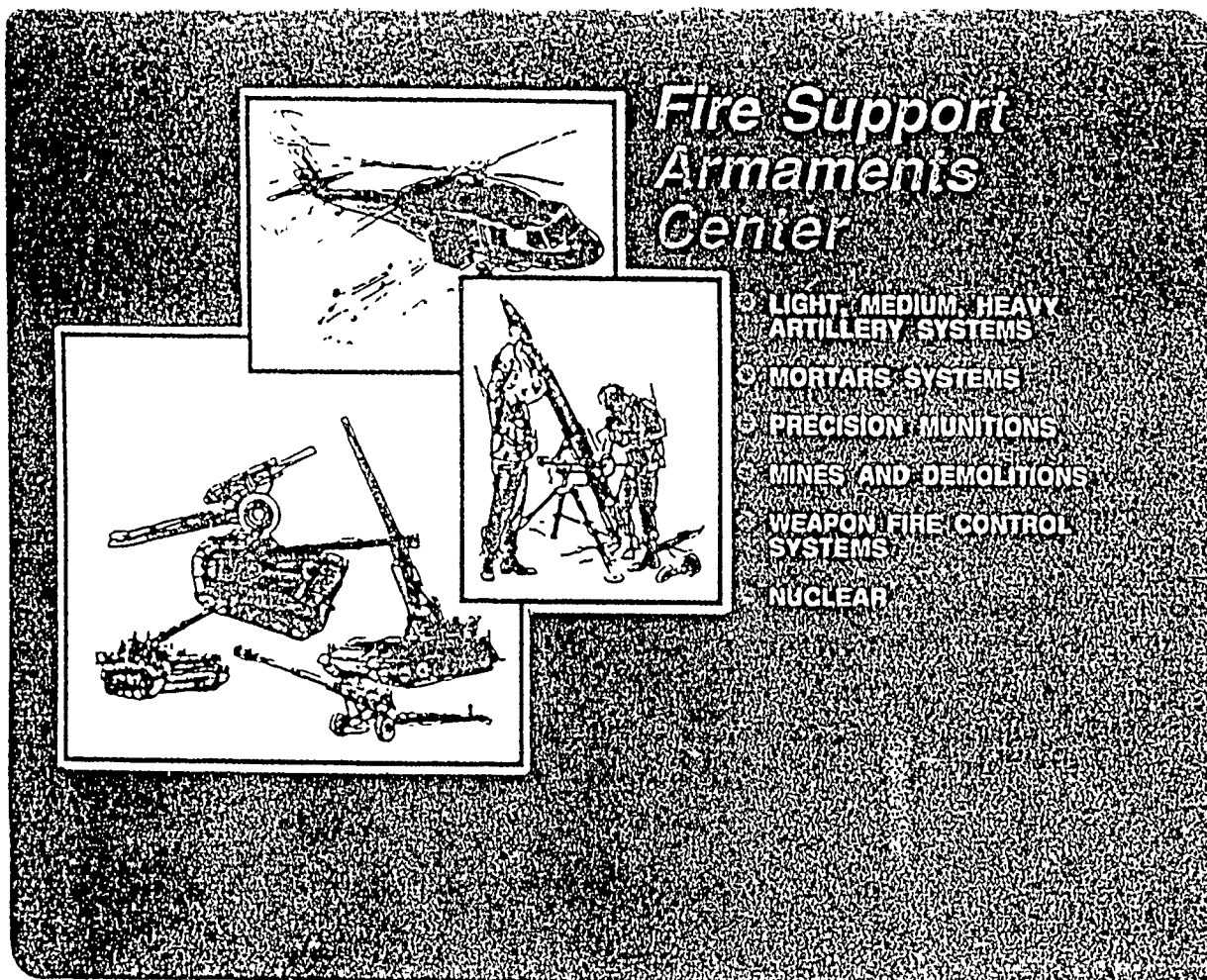
**DECADE OF  
CHANGE**

*Armament Challenges for  
== the 1990's ==*

**90's**



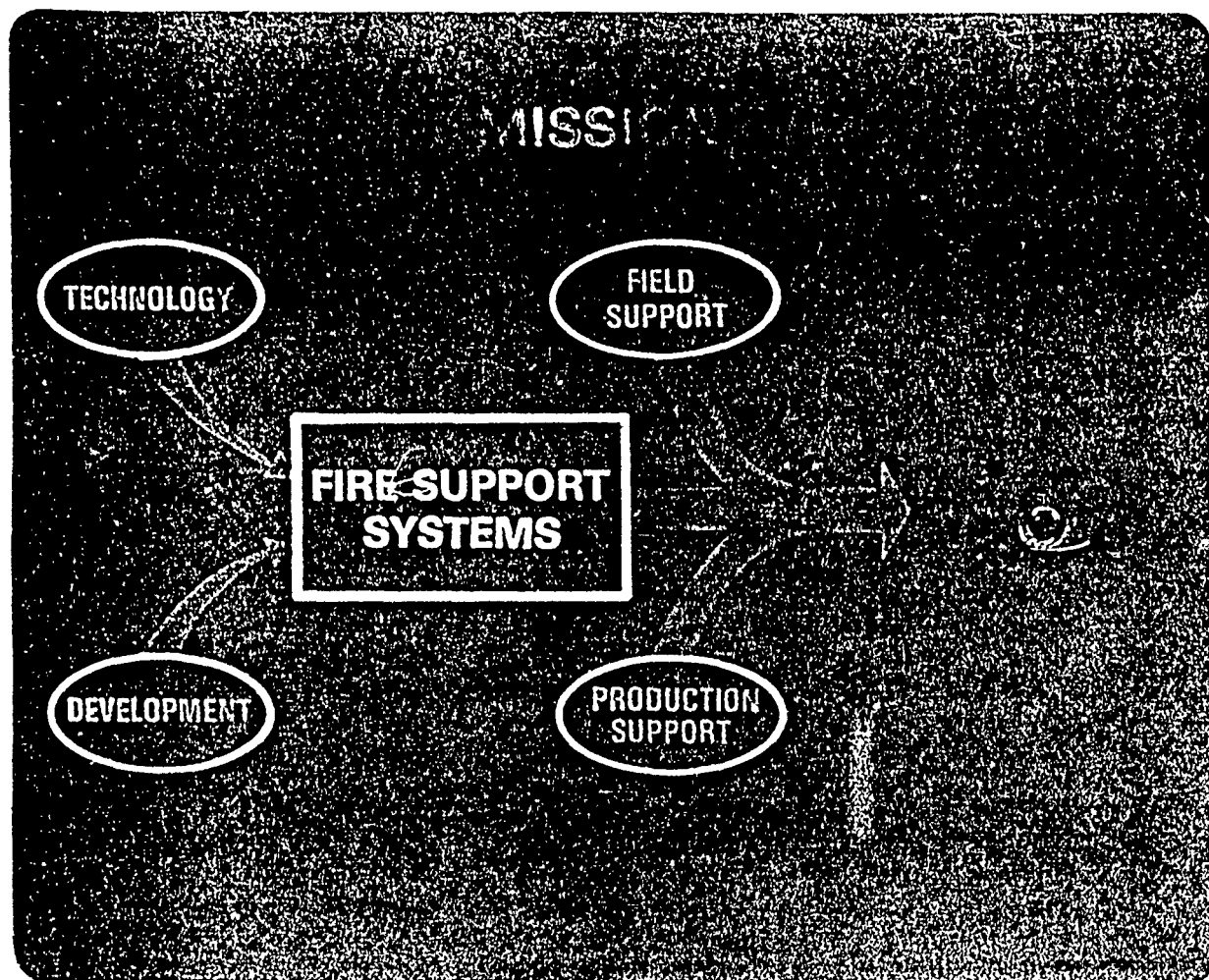
**Advanced  
Planning  
Briefing for  
Industry**



## TALKING SHEET - "FIRE SUPPORT ARMAMENTS CENTER"

FSAC'S MISSION RESPONSIBILITY EXTENDS ACROSS THE SYSTEM AREAS SHOWN HERE

- CANNON ARTILLERY SYSTEMS - TOWED & SELF PROPELLED - 105MM THRU 8 INCH.
- MORTAR SYSTEMS FOR THE INFANTRY - 60, 80, 120MM AND THE OLD 4.2 INCH
- PRECISION MUNITIONS FOR BOTH INDIRECT AND DIRECT FIRE CANNON AND MISSILE SYSTEMS
- MINES AND DEMOLITIONS FOR THE ENGINEERS AND EOD
- FIRE CONTROL FOR ALL ARMY WEAPON SYSTEMS OTHER THAN MISSILES - INCLUDING ARTILLERY, INFANTRY, ARMOR AND AVIATION
- ARMY NON-NUCLEAR COMPONENTS OF NUCLEAR WEAPONS AND SUPPORT FOR NUCLEAR MUNITIONS



#### TALKING SHEET - "MISSION"

- 0 FSAC'S MISSION IS TO PROVIDE THE MOST MODERN, AFFORDABLE AND SUPPORTABLE FIRE SUPPORT ARMAMENTS SYSTEMS POSSIBLE TO THE SOLDIER IN THE FIELD THRU:
- 0 GENERATION OF NEW WEAPONS CONCEPTS IN THE TECHNOLOGY BASE
- 0 DEVELOPMENT OF THESE CONCEPTS INTO DEMONSTRATORS, PROTOTYPES AND FIELDABLE SYSTEMS
- 0 INTRODUCTION OF THESE SYSTEMS INTO THE FIELD AND THEN PROVIDING ENGINEERING SUPPORT TO PRODUCTION AND FIELD SUPPORT FOR THEIR LIFETIME



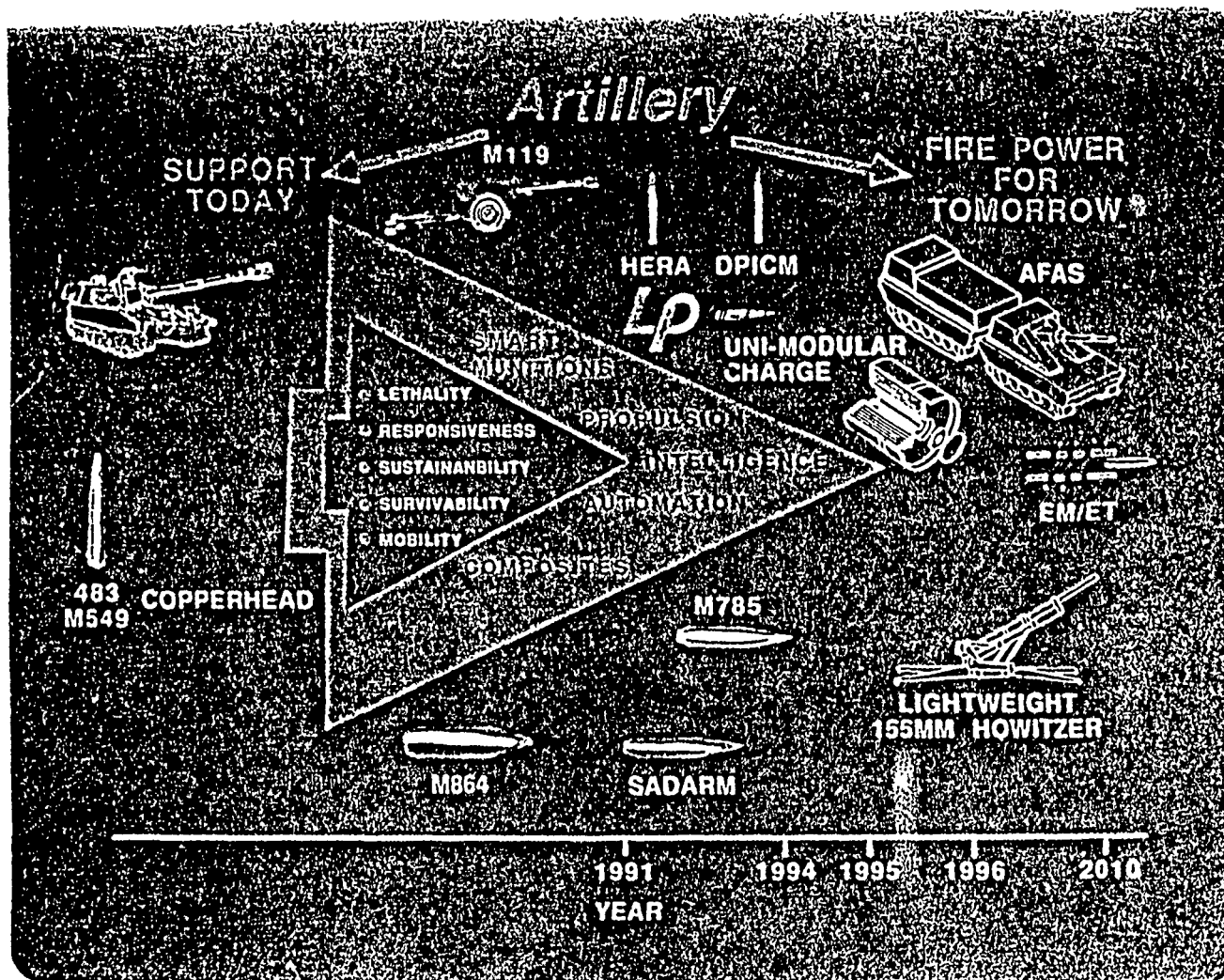
**ARDEC**

## **TECHNICAL THRUSTS**

- **SMART MUNITIONS**
- **SMART MINES**
- **ANTI-ARMOR INITIATIVES**
- **INSENSITIVE MUNITIONS**
- **INDIRECT FIRE ENHANCEMENTS**
- **FIRE CONTROL**
- **LETHAL MECHANISMS**
- **ADVANCED PROPULSION/EXPLOSIVES**
- **INFANTRY EFFECTIVENESS**

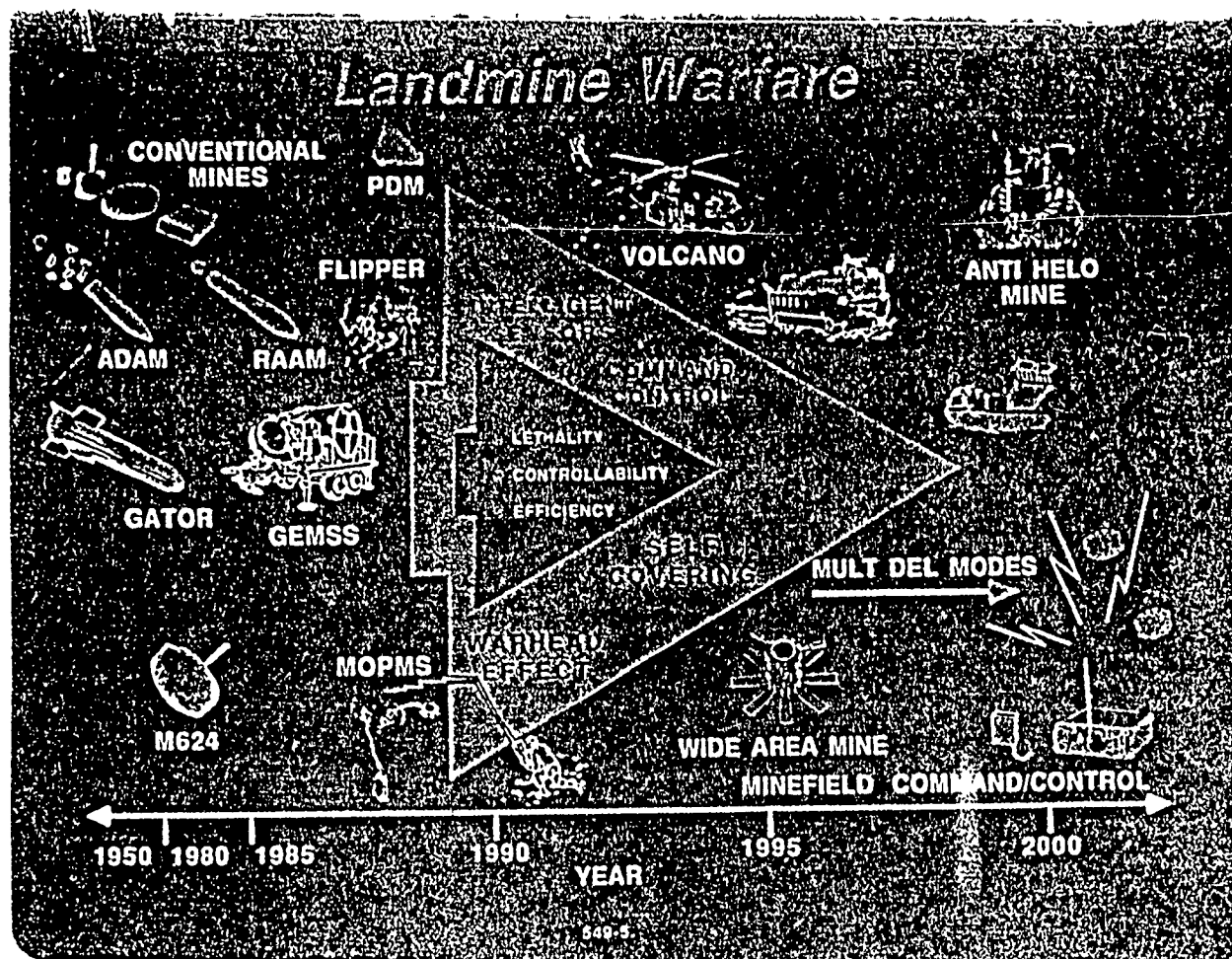
### TALKING SHEET - "THRUSTS"

- 0 LISTED ARE THOSE TECHNICAL THRUSTS WHICH PROVIDE MAJOR SUPPORT TO OUR MISSION AREAS. NOTE THAT THIS CHART ADDRESSES ARDEC'S TECHNICAL THRUSTS. THE AREAS HIGHLIGHTED ARE THE PRIME RESPONSIBILITY OF FSAC. WE ALSO PLAY A MAJOR ROLE IN THE OTHER AREAS. WE TAKE A SYSTEMS APPROACH TO OUR DEVELOPMENT PROGRAMS. I WANT TO USE THAT APPROACH IN OUR MAJOR SYSTEMS AREAS TO ILLUSTRATE WHERE WE HAVE BEEN AND WHERE WE ARE GOING. THE NEXT FEW VIEWGRAPHS ARE AT THE MACRO LEVEL. THE SPECIFICS, WILL BE ADDRESSED BY THE SERIES OF PRESENTATIONS WHICH WILL FOLLOW.



### TALKING SHEET - "ARTILLERY"

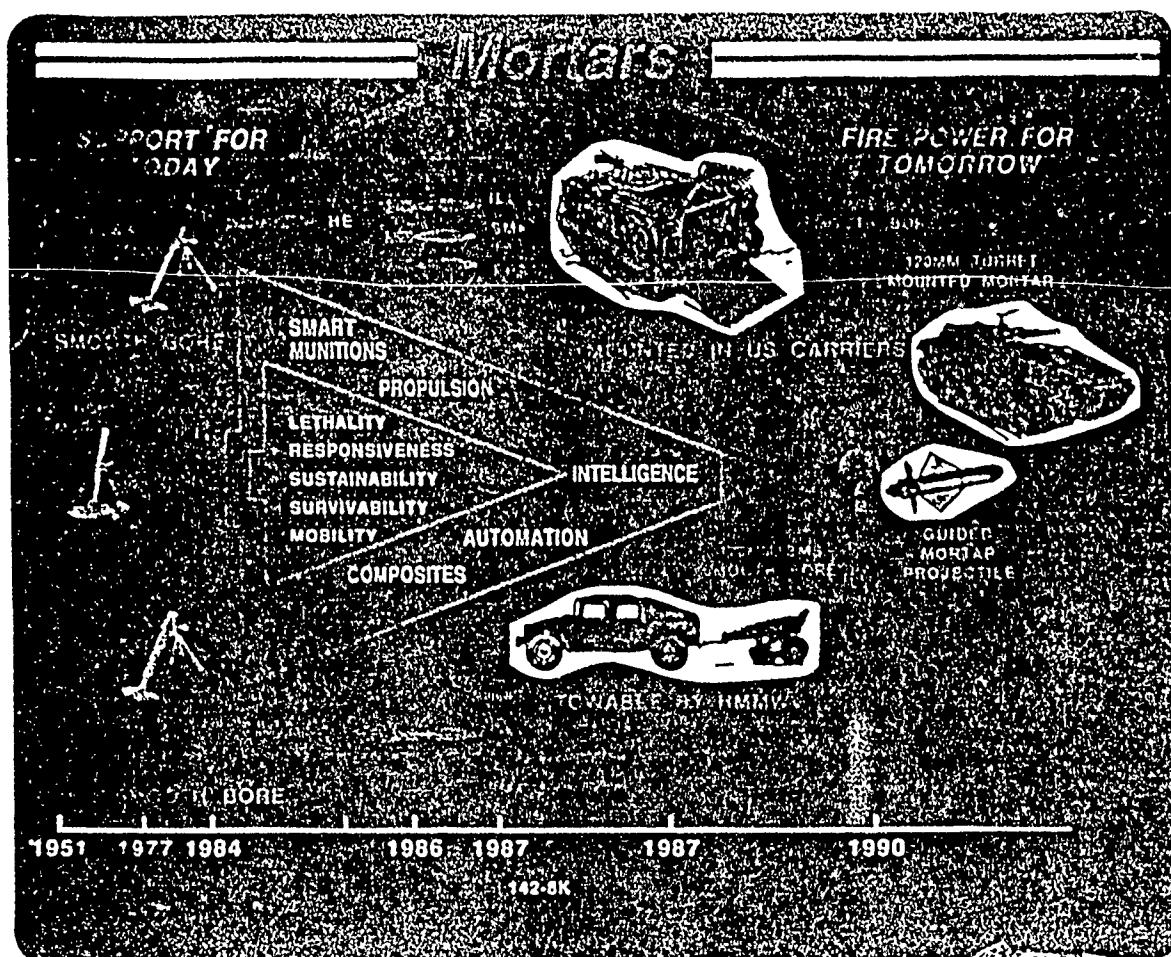
- o FOR THE ARTILLERY MISSION AREA, THIS SLIDE ILLUSTRATES WHERE WE ARE NOW, THE GENERAL AREAS IN WHICH COMBAT CAPABILITIES ARE SOUGHT BY THE USER (LETHALITY THRU MOBILITY), THE TECHNOLOGY THRUSTS THAT WE BELIEVE WILL LEAD TO THAT INCREASED CAPABILITY (SUCH AS SMART MUNITIONS), AND THE TYPES OF SYSTEMS THAT WILL BE FIELDIED INCLUDING AFAS AND FARV-A.
- o THIS SLIDE IS NOT ALL INCLUSIVE, HOWEVER, IT DOES SHOW THAT CANNON FIELD ARTILLERY SYSTEMS ARE RIGHT ON THE EDGE OF SIGNIFICANT INCREASES IN COMBAT CAPABILITY.



## TALKING SHEET - "LANDMINE WARFARE"

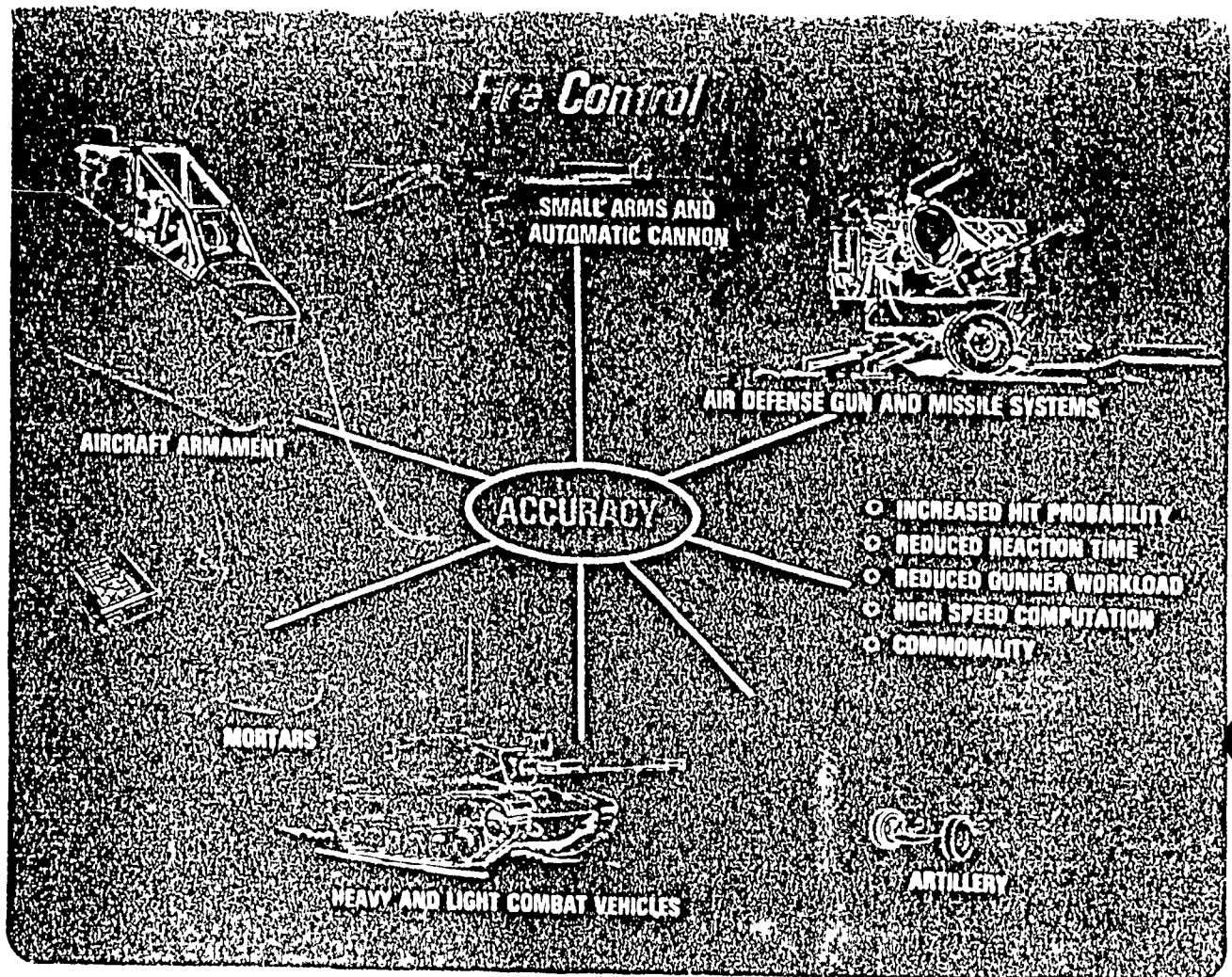
- o MINES AND DEMOLITIONS ARE ANOTHER FSAC PRINCIPLE MISSION AREA
- o GREAT STRIDES HAVE BEEN MADE IN MINE SYSTEMS EFFECTIVENESS: AS SCATTERABLE MINE TECHNOLOGY, FIRST FIELDIED AS FIELD ARTILLERY SCATTERABLE MINES, HAS BEEN PROLIFERATED TO AIRBORNE AND GROUND SCATTERABLE MINE SYSTEMS.
- o DEFENSE SCIENCE BOARD STUDY OF 1986 -
  - o IDENTIFIED A SIGNIFICANT INCREASE IN MINE LETHALITY AND EFFECTIVENESS ON THE BATTLEFIELD THAT COULD RESULT FROM APPLICATION OF SMART MUNITION TECHNOLOGY, IMPROVED WAR-HEADS, AND COMMAND AND CONTROL TO PROVIDE A LEAP AHEAD IN THE COMBAT EFFECTIVENESS OF MINEFIELDS ON THE MODERN BATTLEFIELD.





## TALKING SHEET - "MORTARS"

- o ANOTHER MAJOR SYSTEMS AREA IS THAT OF MORTARS
- o CURRENTLY, MORTARS REPRESENTS A VERY MATURE TECHNOLOGY WHICH PROVIDES HIGHLY LETHAL, CLOSE-IN FIRE SUPPORT IN LIGHT WEIGHT SYSTEMS OFFERING TACTICAL AND STRATEGIC MOBILITY.
- o FOR THE INFANTRY, WE HAVE FIELDIED A WHOLE NEW FAMILY OF MORTARS AND MORE EFFECTIVE AMMUNITION
  - o 60MM LIGHT MORTAR - DEVELOPED IN-HOUSE
  - o 81MM MORTAR - NON-DEVELOPMENTAL ITEM
- o LIGHT AND MECHANIZED FORCES THE 120MM MORTAR - ANOTHER H.A. HAS BEEN TYPE CLASSIFIED
- o NEW TECHNOLOGIES - SIMILAR TO THOSE FOR ARTILLERY SYSTEMS - CAN PROVIDE IMPROVED CAPABILITIES IN THE FUTURE, BUT WE NEED TO HELP THE USER DECIDE WHERE HE WANTS TO GO FOR ADVANCED MORTAR SYSTEMS IN SUCH AREAS AS
  - o TURRETED SELF-PROPELLED MORTARS AND
  - o GUIDED MORTAR PROJECTILES



### TALKING SHEET - "FIRE CONTROL"

- FIRE CONTROL IS A MISSION AREA WHICH SUPPORTS NOT ONLY FSAC MISSION RESPONSIBILITIES IN ARTILLERY AND OTHER INDIRECT FIRE WEAPON SYSTEMS, BUT THE DIRECT FIRE SYSTEMS SHOWN AS WELL. TANKS, HELICOPTERS, AND INFANTRY WEAPONS.
- THE PAYOFF IN IMPROVED FIRE CONTROL ACCURACY AND REDUCED PROCESSING TIME ARE SHOWN. THESE IMPROVED CAPABILITIES LEAD LOGICALLY TO GREATER LETHALITY AND SURVIVABILITY. THIS IS CLEARLY AN AREA WHERE AMERICAN TECHNOLOGY CAN BE LEVERAGED INTO A SIGNIFICANT COMBAT MULTIPLIER.

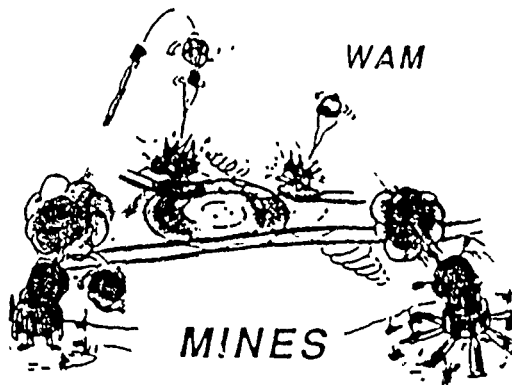
## Smart Munition Programs



SADARM

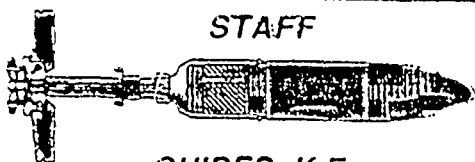


155MM FIRE & FORGET  
ARTILLERY



WAM

MINES



STAFF

GUIDED K.E.



TANKS



LIGHTWEIGHT  
DIRECT FIRE

FIRE & FORGET  
MORTAR



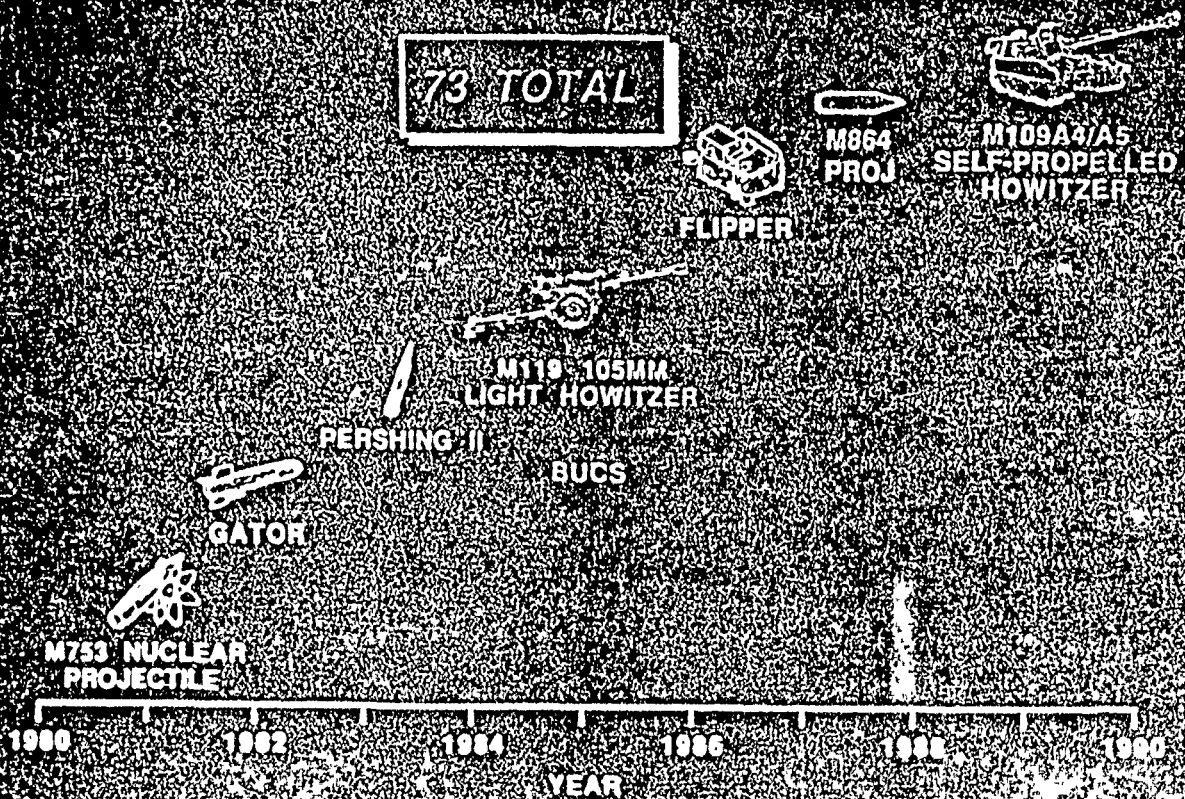
INFANTRY

TALKING SHEET - AND FINALLY "SMART MUNITIONS" FOR ALL TYPES OF ARMAMENT SYSTEMS.

- o FSAC IS THE LEADER IN THE DEVELOPMENT OF GUN HARDENED PRECISION MUNITIONS. WE ARE ALSO THE LEAD FOR SENSING MUNITIONS. WE ARE DEVELOPING SADARM FOR MLRS/155MM, WAM FOR THE COMBAT ENGINEERS, STAFF AND X-ROD FOR THE TANKERS, AND HAVE DEMONSTRATED THE TECHNOLOGY FOR DIRECT FIRE INFANTRY WEAPONS AND GUIDED MORTAR PROJECTILES.

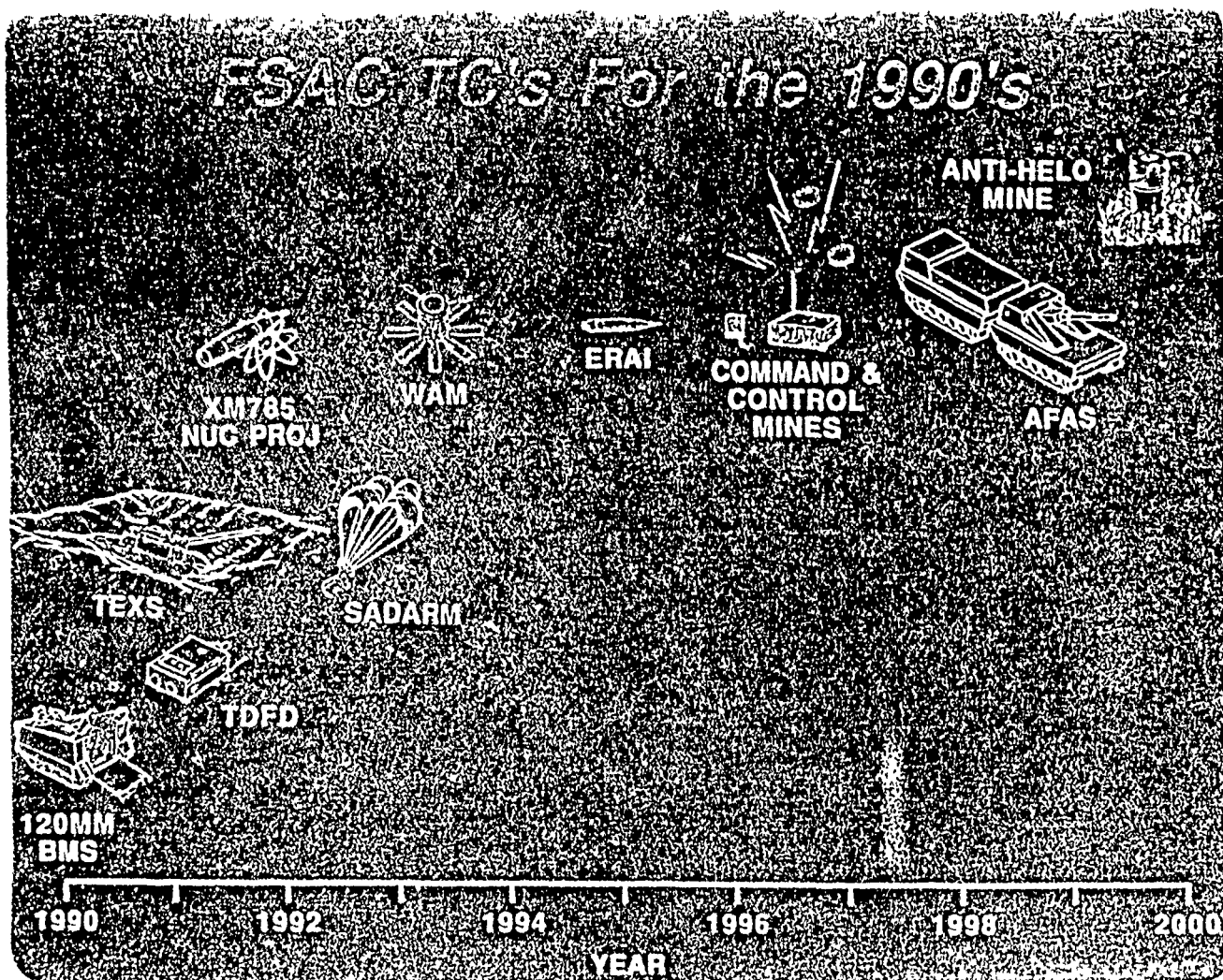
# FSAC TC's For The 1980's

73 TOTAL



## TALKING SHEET - "FSAC TC's FOR THE 1980's"

C IN THE PAST DECADE WE HAVE BROUGHT 73 SYSTEMS TO TYPE CLASSIFICATION, SOME OF WHICH ARE ILLUSTRATED HERE.



## TALKING SHEET - FSAC TC's FOR THE 1990's

- o IN THE NEXT DECADE WE HAVE TYPE CLASSIFICATION SCHEDULES FOR ANOTHER 50 OR SO SYSTEMS. AS THE DECADE PROGRESSES, THE LIST WILL SURELY CHANGE. BUT, OUR MUTUAL EFFORTS TO PROVIDE THE AMERICAN SOLDIER WITH THE FINEST EQUIPMENT AVAILABLE WILL CONTINUE.
- o I'LL WRAP UP MY COMMENTS WITH AN INTRODUCTION TO THE PRESENTATIONS YOU WILL RECEIVE OVER THE NEXT TWO DAYS.

# DECADE OF CHANGE "1990'S"

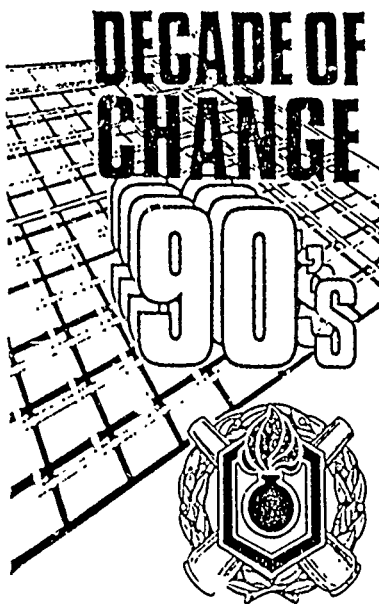
## *Common Briefing Outline*

- What Is
- Program Overview
- Program Focus
- Status
- Plans
- Challenge To Industry
- Summary

### TALKING SHEET - "COMMON BRIEFING OUTLINE"

- O TECHNICAL PRESENTATIONS YOU WILL BE HEARING GIVEN BY FSAC AND OTHER ARDEC PERSONNEL FOLLOW A COMMON BRIEFING OUTLINE:
  - O WHAT IS (EXPLANATION OF WHAT PROGRAM ENTAILS)
  - O PROGRAM OVERVIEW (DETAILS OF PROGRAM TODAY)
  - O PROGRAM FOCUS (WHERE WE WANT TO GO)
  - O STATUS (PRESENT CONDITIONS)
  - O PLANS (MILESTONES AND DOLLARS)
  - O CHALLENGE TO INDUSTRY (WHERE WE NEED YOUR HELP)
  - O SUMMARY
- O EACH PRESENTATION WILL BE FOLLOWED BY A SHORT QUESTION AND ANSWER PERIOD. IF, WHEN THE CONFERENCE HAS ENDED, YOU STILL HAVE QUESTIONS, FEEL FREE TO CONTACT MY OFFICE.

Advanced  
Planning  
Briefing for  
Industry



*Armament Challenges for  
the 1990's . . .*

## *Closing Remarks*

PRESENTED BY

COLONEL GERARD JAMES

FIRE SUPPORT ARMAMENTS CENTER  
724-6196

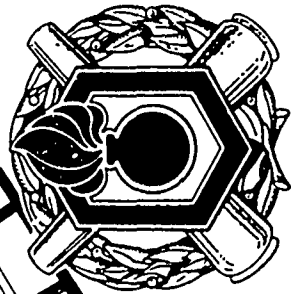
WHILE MOST OF THE PRESENTATIONS YOU WILL HEAR IN THE NEXT TWO DAYS WILL BE PRESENTED BY MY STAFF IN THE FIRE SUPPORT ARMAMENTS CENTER, THERE IS FAR MORE TO PICATINNY THAN FSAC AND THE ARMAMENTS RESEARCH, DEVELOPMENT AND ENGINEERING CENTER. THIS IS ALSO THE HOME OF THE PROGRAM EXECUTIVE OFFICER FOR ARMAMENTS AND HIS REPORTING PROJECT MANAGERS, TWO OF THE PROJECT MANAGERS FOR THE ARMORED SYSTEMS MODERNIZATION PEO, SEVERAL AMC PROJECT MANAGERS AND NUMEROUS AMCCOM ORGANIZATIONS. WE ALSO HAVE REPRESENTATION FROM OTHER LABORATORIES, COMMANDS AND EVEN ALLIED NATIONS. WE STRIVE TO WORK TOGETHER AS A TEAM.

RECALL MR. SINGLEY'S MATRIX OF MODERNIZATION PLANS AND EMERGING TECHNOLOGIES:

AS A TEAM WE ARE INVOLVED IN SUPPORT OF EVERY ONE OF THE MODERNIZATION PLANS IN SOME MANNER AND NEARLY EVERY TECHNOLOGY LISTED. I URGE YOU TO JOIN OUR TEAM.

**Advanced  
Planning  
Briefing for  
Industry**

**DECADE OF  
CHANGE  
90'S**



**Armament Challenges for  
the 1990's . . .**

# ***Electric Guns***

PRESENTED BY

**DR. THADDEUS GORA**

**FIRE SUPPORT ARMAMENTS CENTER  
724-3353**



# ***Briefing Outline***

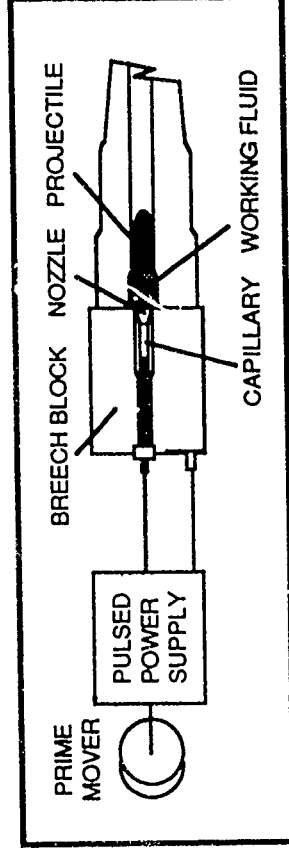
- What Is Electric Launch ?
- Program Overview
- Program Focus
- Status
- Plans
- Challenge To Industry
- Summary

# **What Are Electric Launchers ?**

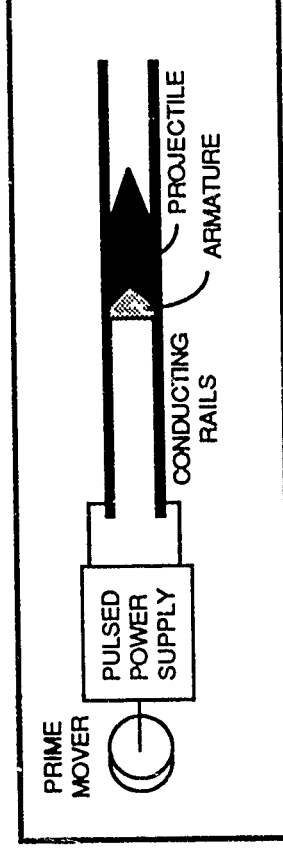
- **Guns That Use Electrical Energy To Propel Projectiles**
- **Achieve Increased Velocity, Range And Energy On Target**

# **Electric Gun Classes**

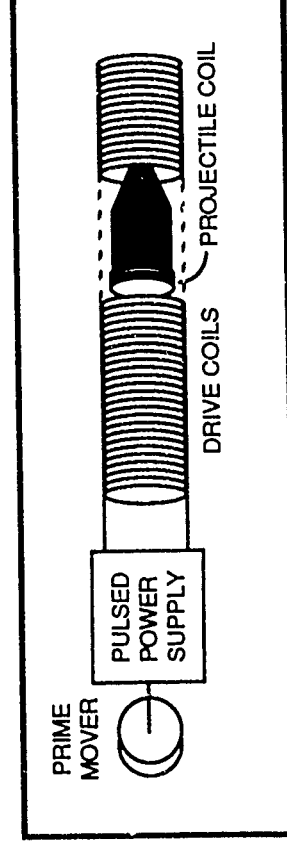
## **Electrothermal- Chemical (ETC) Gun**



## **Electromagnetic (EM) Railgun**



## **Electromagnetic (EM) Coilgun**



# Program Overview

## ELECTROTHERMAL-CHEMICAL LAUNCH

<p><u>Objective:</u></p> <p>Exploit The Benefits Of Electrothermal-Chemical Launchers For Tank And Artillery Applications</p>	<p><u>Technology Barriers:</u></p> <ul style="list-style-type: none"><li>● Power Supply Weight And Size</li><li>● Combustion Control</li><li>● Viable Working Fluid</li><li>● Zoning Solution</li></ul>
<p><u>Needed Technology:</u></p> <ul style="list-style-type: none"><li>● Compact Power Supplies<ul style="list-style-type: none"><li>● Batteries 100 MJ (0.4 m<sup>3</sup> &amp; 500 kg)</li><li>● Capacitors 4 MJ (0.15 m<sup>3</sup> &amp; 130 kg)</li><li>● Integrated Pulse Forming Network (2-3 m<sup>3</sup>)</li></ul></li><li>● Energetic And Stable Working Fluids</li></ul>	<p><u>Pay Offs:</u></p> <ul style="list-style-type: none"><li>● Increased:<ul style="list-style-type: none"><li>● Energy On Target</li><li>● Projectile Mass</li><li>● Range</li></ul></li><li>● Use Existing Tubes And Ammo</li></ul>

# ***Program Overview***

## **ELECTROMAGNETIC LAUNCH**

<p><b><u>Objective:</u></b></p> <p>Exploit The Benefits Of Electromagnetic Launchers For Tank Applications</p>	<p><b><u>Technology Barriers:</u></b></p> <ul style="list-style-type: none"><li>● Power Supply Weight And Size</li><li>● Barrel Erosion</li><li>● Launcher Efficiency</li></ul>
<p><b><u>Needed Technologies:</u></b></p> <ul style="list-style-type: none"><li>● Compact Power Supplies</li><li>● Compulsator 50- MJ/pulse (1.2 m<sup>3</sup> &amp; 2,700 kg)</li><li>● Improved Thermal Management</li><li>● Improved High Current Transfer</li><li>● Hypervelocity Projectile Design</li></ul>	<p><b><u>Pay Offs:</u></b></p> <ul style="list-style-type: none"><li>● Increased:<ul style="list-style-type: none"><li>● Velocity</li><li>● Range</li><li>● Energy On Target</li></ul></li><li>● Uniform Acceleration</li><li>● Reduced Logistics Costs</li><li>● Reduced Blast/Flash</li></ul>

# Supporting Technology

## EM Launchers

- Coilguns
- RAILGUNS
- COMPOSITE BARRELS
- Inductive Accelerators
- ET/EM Hybrids
- COMPULSATORS
- CAPACITORS
- LI-MS BATTERIES
- Rising Frequency Gen
- Seac Hpg
- Variable Inductor

## Pulse Power

## Armatures

- Solid
- Plasma
- Transition

## Switching

- Long Life Mech
- Solid State

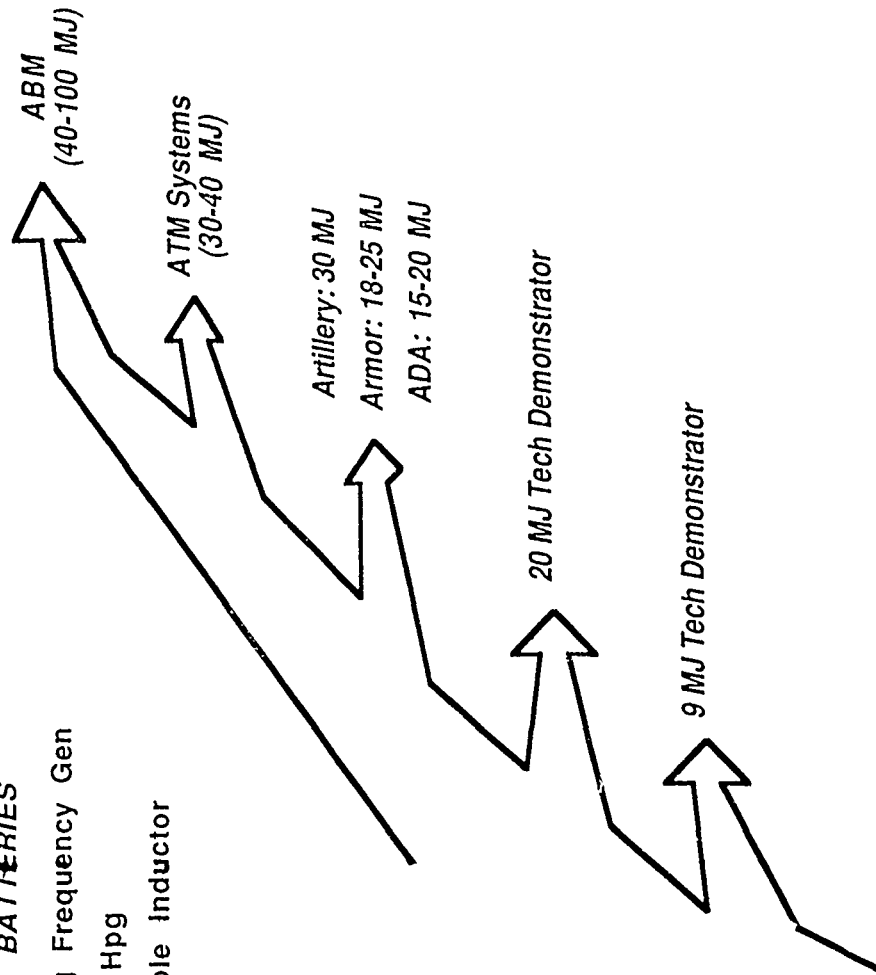
## ETC Guns

- PLASMA CARTRIDGES
- WORKING FLUIDS

## Hypervelocity Projectiles

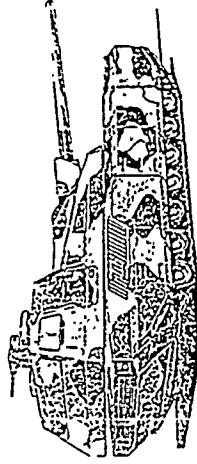
## Simulations & Analysis

- Ballistics
- Induction Modes
- GUN PROJECTILE OPTIMIZATION
- Instrumentation & Diagnostics



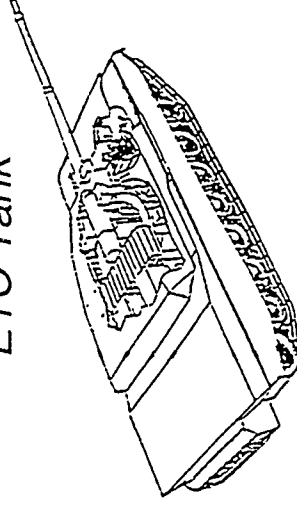
# Focus On Systems Applications

ETC Artillery



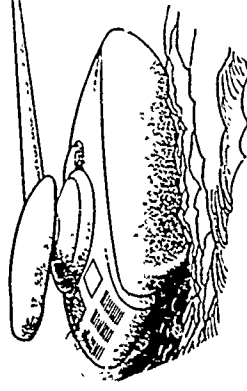
- 155MM, 30 MJ
- Compulsator, Alternator Or Battery/Capacitor Pulse Forming Network
- Existing And Longer Range Artillery Rounds
- 16 Rounds/Min Maximum
- 6 Rounds/Min Sustained

ETC Tank



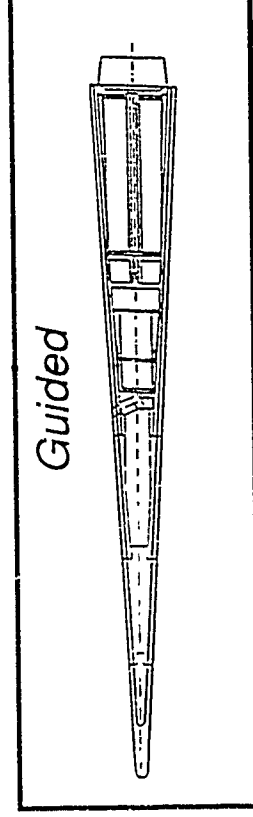
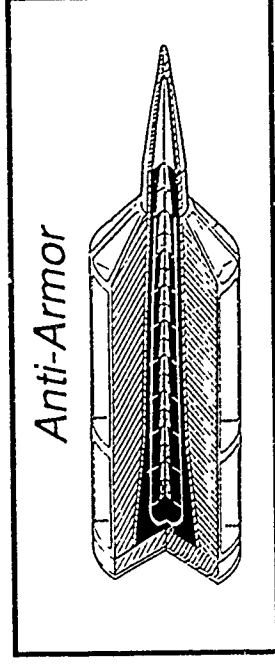
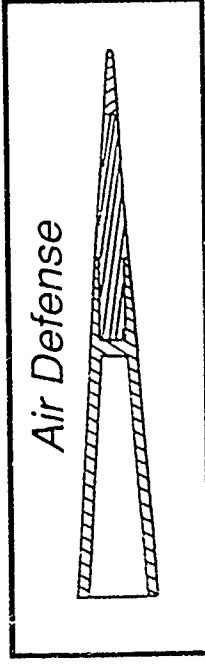
- 120MM, 17 MJ, 1.7 km/sec
- Compulsator, Alternator Or Battery/Capacitor/Pulse Forming Network
- Long Rod Penetrators
- 8 Rounds/Min - 17 Round Burst
- 40 Rounds Stowed

EM Tank



- 105-130MM Railgun
- 19-22 MJ Muzzle Energy
- Compulsator Powered
- <15 Ton System Weight
- 10 Rounds/Min @ 2-3 km/sec

# ***Focus EM Hypervelocity Projectiles***



- Demos @ 20 MJ Kinetic Energy
- 105MM - 130MM Bore
- 100,000 G Maximum

- EM Environment
- Aeroheating
- Stability
- Tank 5.4 KG @ 2.5 Km/Sec
- Air Defense 2.0 Kg @ 3.5 Km/Sec



# Focus - Electric Gun Projectiles

## Today's Velocity

ARTILLERY	155MM	47.0 kg @ 0.8 km/sec - 15 MJ
TANK	120MM	7.0 kg @ 1.7 km/sec - 10 MJ
AIR DEFENSE	40MM	0.9 kg @ 1.1 km/sec - 0.5 MJ

## Demonstrated Velocity

2.4 kg	@ 2.3 km/sec
1.1 kg	@ 3.4 km/sec
2.0 Grams	@ 6.0 km/sec

## Velocity Goals

ARTILLERY	50.0 kg @ 1.1 km/sec - 30 MJ
ETC TANK	11.7 kg @ 1.7 km/sec - 17 MJ
EM TANK	5.4 kg @ 2.5 km/sec - 17 MJ
AIR DEFENSE	2.0 kg @ 3.5 km/sec - 12 MJ

# Status - Technology

## Launched

- ARC Armature - 2 grams To 6 km/sec ..... UT-CEM
- ARC Armature - 1.14 kg To 3.5 km/sec ..... MAXWELL
- Solid Armature - 2.4 kg To 2.6 km/sec ..... UT-CEM
- Electrothermal - Working Towards Weapon ..... FMC, GD  
Level Performance

## Compact Pulse Power Supplies

- Capacitors - 3 KJ/kg - Lab Proven Technology ..... MAXWELL
- Compulsator - 3.5 KJ/kg - In Development ..... UT-CEM

# Plans

## Electric Gun Schedule

System	Gun Prop	90	91	92	93	94	95	96	97	98	99	00
Tank	EM	9 MJ Skid Gun	20 MJ Skid									
Tank/ Artillery	ETC											
Artillery	ETC											
Tank/ Artillery	EM/ ETC											
FUNDING		\$40M	\$40M	\$60M	\$60M	\$60M	\$70M	\$70M	\$80M	\$80M	\$80M	\$80M

INDICATES NEW START

# **Challenge To Industry**

## ***Demonstrate Maturity Of Electrical Launch For Tactical Application In 1993-94***

- Weapon Level Performance
- Mobile
- Multiple Shot
- Further Development Of Tech Base
  - *Launchers* - Rigid, Lightweight, Durable
  - *Armatures* - Maintain Good Electrical Contact
  - *Projectiles* - Survive High Acceleration
  - *Pulse Power* - Higher Power And Energy Densities
  - *Switching* - Durable, Reliable
  - *Working Fluids* - For ET Guns, Fieldable Compounds
  - *Simulations and Analysis* - Accurate Predictability
- Innovative Ideas (e.g.; High Temp Superconductors For Higher Efficiency Launchers And Power Supplies)

## ***ARDEC Facilities Available***

- New 65 MJ Capacitor Power Supply - Spring 1991
- Existing 30 MJ Homopolar Generator

# ***Summary***

## ***Project Summary***

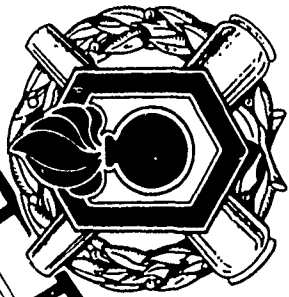
- Tactical Demo Program Established
- Near Term Hardware Capabilities Coming
  - 9 MJ Single Shot Lab Guns Operational
  - 9 MJ & 20 MJ Skid Gun Demos Coming

## ***Industry Participation Needed In Following Areas***

- Compact Power Supplies
- State-Of-The-Art Materials
- Higher Efficiencies
- Optimized Projectiles

**Advanced  
Planning  
Briefing for  
Industry**

**DECADE OF  
CHANGE  
90'S**



**Armament Challenges for  
the 1990's . . .**

# ***Insensitive Munitions***

**PRESENTED BY**

**PATRICK SERAO**

**U.S. ARMY INSENSITIVE MUNITIONS OFFICE  
724-3072**

# ***Briefing Outline***

- What Are Insensitive Munitions ?
- Program Overview
- Program Focus
- Status
- Plans
- Challenge To Industry
- Summary

## ***What Is IM ?***

**An Insensitive Munition Is Defined As A Munition That Will Reliably Fulfill Performance, Readiness And Operational Requirements On Demand But Will Minimize The Violence Of A Reaction And Subsequent Collateral Damage When Subjected To Unplanned Stimuli Or Threat Attack**



# ***Joint Service IM Initiative***

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- CNO IM Decision Memo Signed In 1984
- Joint Service Requirement For Insensitive Munitions Signed June 1987 By Service Secretaries
  - Services Conduct Assessment Of Munitions
  - Where Practical, Make Insensitive
  - Maintain Operational Requirement
- Services IM Thrusts - Logistics Survivability And
  - ARMY - Combat System Survivability
  - NAVY - Ship Survivability
  - AIR FORCE - Air Base Survivability And Quantity-Distance

# Tech Requirements For IM

## Test

## Criteria

● Fast Cookoff	● Burning Reaction Max
● Bullet Impact	● Burning Reaction Max
● Fragment Impact	● Burning Reaction Max
● Sympathetic Detonation	● No Sympathetic Detonation
● Slow Cookoff *	● Burning Reaction Max
● Shaped Charge Jet *	● No Detonation
● Shaped Charge Spall *	● No Sustained Burning
● Vulnerability Tests **	● **

MIL STD  
2105A

\* REQUIRED IF DETERMINED TO BE CREDIBLE THREATS VIA THREAT HAZARD ASSESSMENT

\*\* SYSTEM SPECIFIC TESTS AND CRITERIA DEPENDING ON VULNERABILITY REQUIREMENTS. (MAY INCLUDE TAILORING OF THREAT DEPENDENT MIL-STD TESTS)

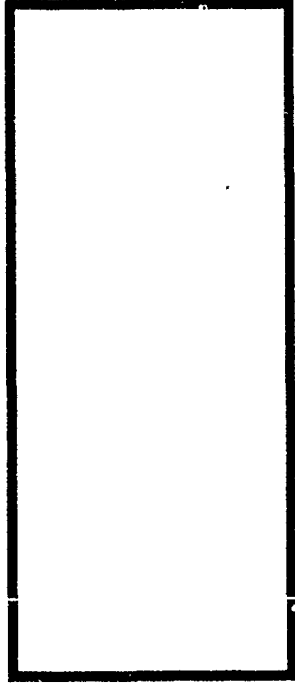
# Program Overview

<p><u>Objective:</u></p> <ul style="list-style-type: none"> <li>● Development Of Munition/Missile Systems Which Will               <ul style="list-style-type: none"> <li>● Reduce System Vulnerability To Attack By Unplanned Stimuli</li> <li>● Improve Logistics Survivability</li> </ul> </li> </ul>	<p><u>Technology Barriers:</u></p> <ul style="list-style-type: none"> <li>● Vulnerability Diagnostics Inadequate</li> <li>● Performance Trade-Offs With Vulnerability</li> <li>● Inadequate Material Properties</li> </ul>
<p><u>Needed Technologies</u></p> <ul style="list-style-type: none"> <li>● Improved Binder/Plasticizer Technology</li> <li>● Improved Nitramine Technology</li> <li>● Improved Predictive Modeling And Lab Scale Testing Techniques</li> <li>● Improved Processing Technology</li> </ul>	<p><u>Pay Offs:</u></p> <ul style="list-style-type: none"> <li>● Increase Combat System Survivability</li> <li>● Minimize Impact Of Enemy Action/Accident</li> <li>● Increase Storage Efficiency</li> <li>● Provide Safer And Less Costly Transportation And Storage</li> </ul>

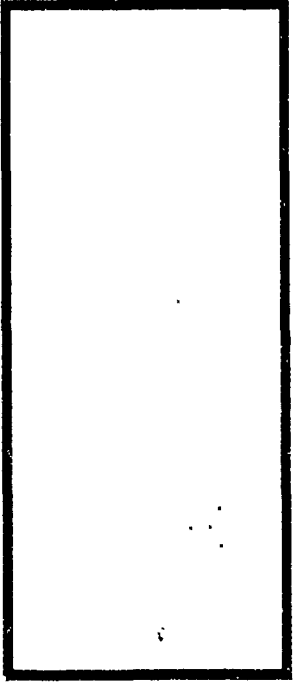
# ***Insensitive Munitions***

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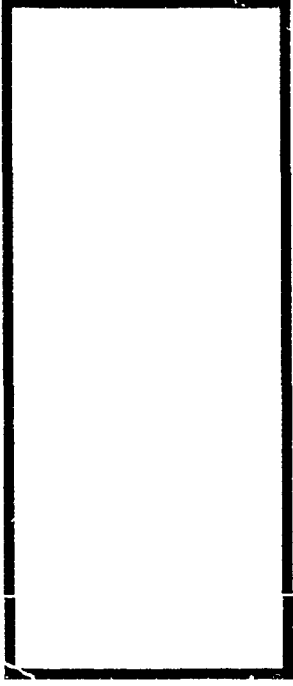
## ***Program Focus***



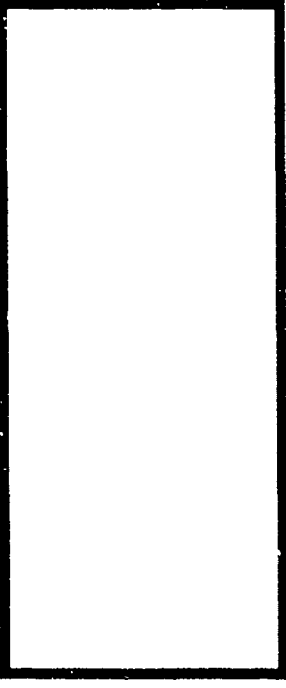
***Missile Systems***



***Ordnance Protection***



***Gun/Tank Propellants***



***Explosive Warheads***

## INSENSITIVE PROPELLANTS AND EXPLOSIVES

# **Program Focus**

- Replace Current Explosive Fills With Insensitive Formulations
- Develop Insensitive Propellant Formulations
- Understand Mechanisms Of Reaction To Threats
- Demonstrate Reduced Vulnerability And Performance

## INSENSITIVE EXPLOSIVES

# ***Status***

- Technology Is Directed To Eliminate/Reduce Sensitivity To Mechanical Stimuli
- Candidate Explosive (PAX-2) Developed For 25MM M792 HEI
- Scale Up And Loading Study Of PAX-2 For Application To Shaped Charge Warheads Initiated
- Joint Army/Navy Vulnerability And Performance Test And Evaluation Program Ongoing

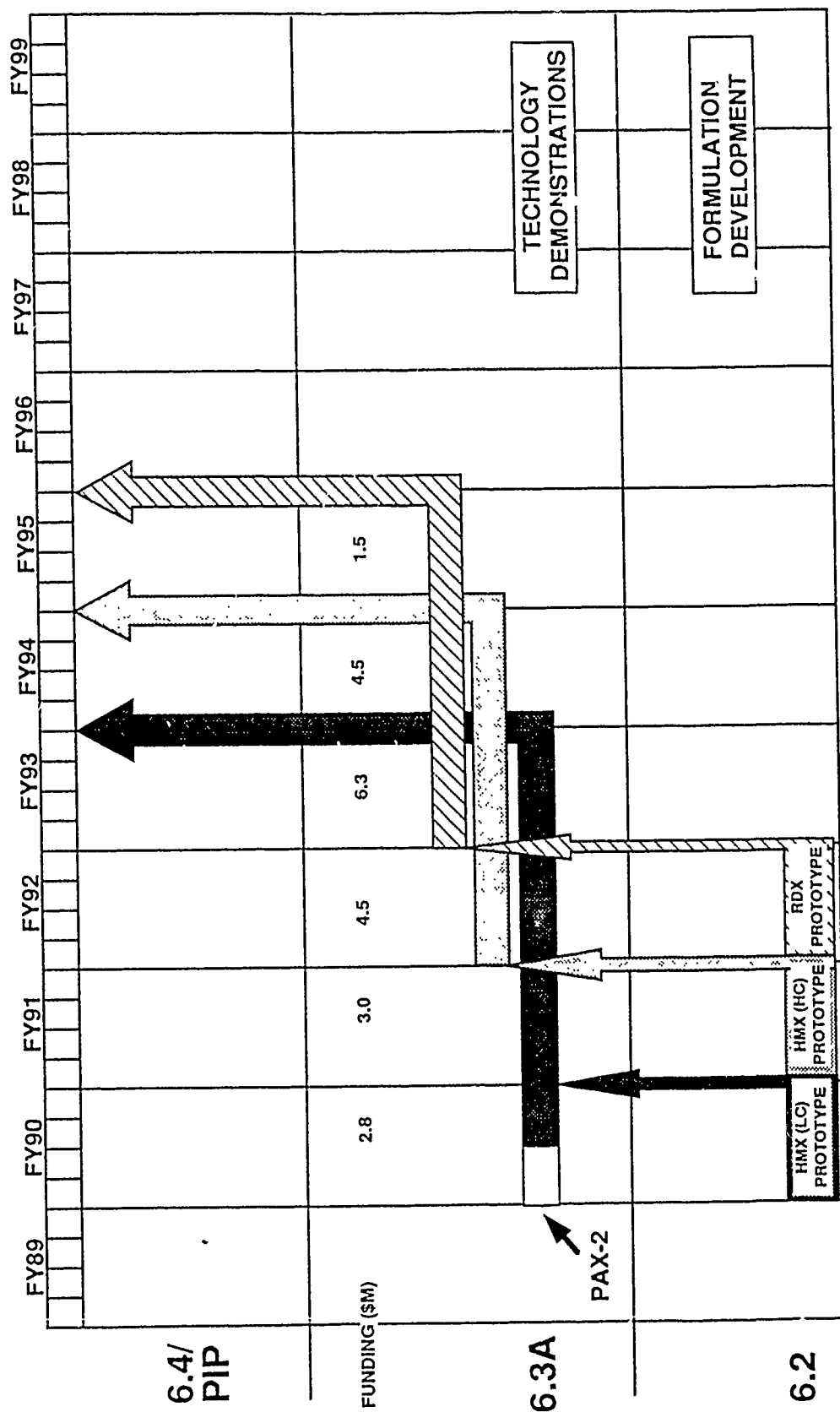
# INSENSITIVE EXPLOSIVES

## **Objective**

Replace Current Explosive Fills With Insensitive Formulations

<i><b>HMX Based</b></i>		<i><b>RDX Based</b></i>	
<i><b>LX-14 (LC)</b></i>	<i><b>LX-14 (HC)</b></i>	<i><b>COMP A-5</b></i>	<i><b>PBX-0280</b></i>
<b>HELLFIRE</b>	<b>SADARM</b>	<b>M864</b>	<b>VOLCANO</b>
<b>AAWS-M</b>	<b>WAM</b>	<b>MLRS</b>	<b>GATOR</b>
<b>TOW 2B</b>			
<b>LOS-F-H</b>			
<b>NLOS</b>			

# INSENSITIVE EXPLOSIVES FUTURE PLANS





# INSENSITIVE PROPELLANTS

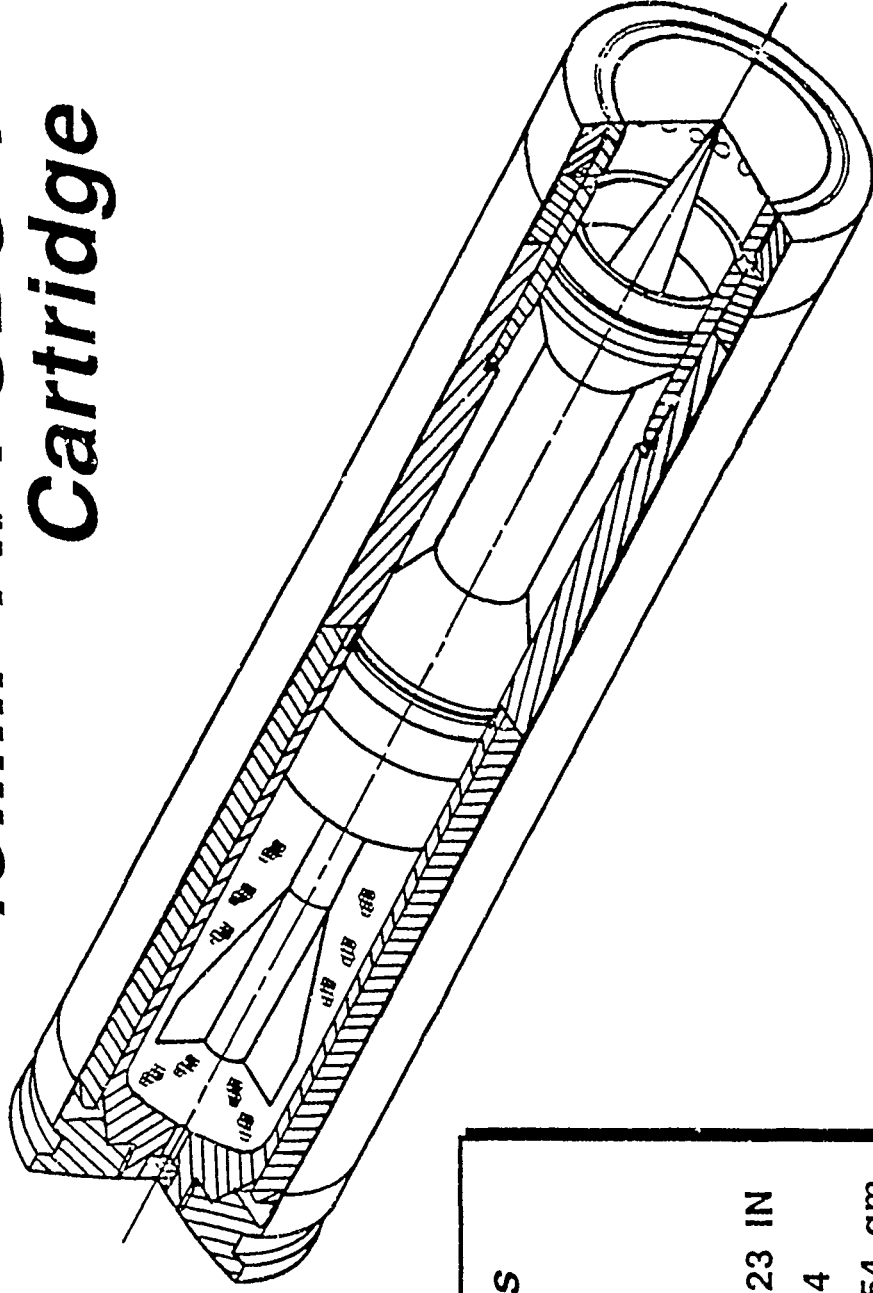
## ***Objectives***

### ***Develop Insensitive Propellant Formulations***

- Unicharge
- M919 (25MM)
- Combat Vehicle Armament Technology (COMVAT)
- Advanced Tank Cannon System (ATAC)

COMVAT

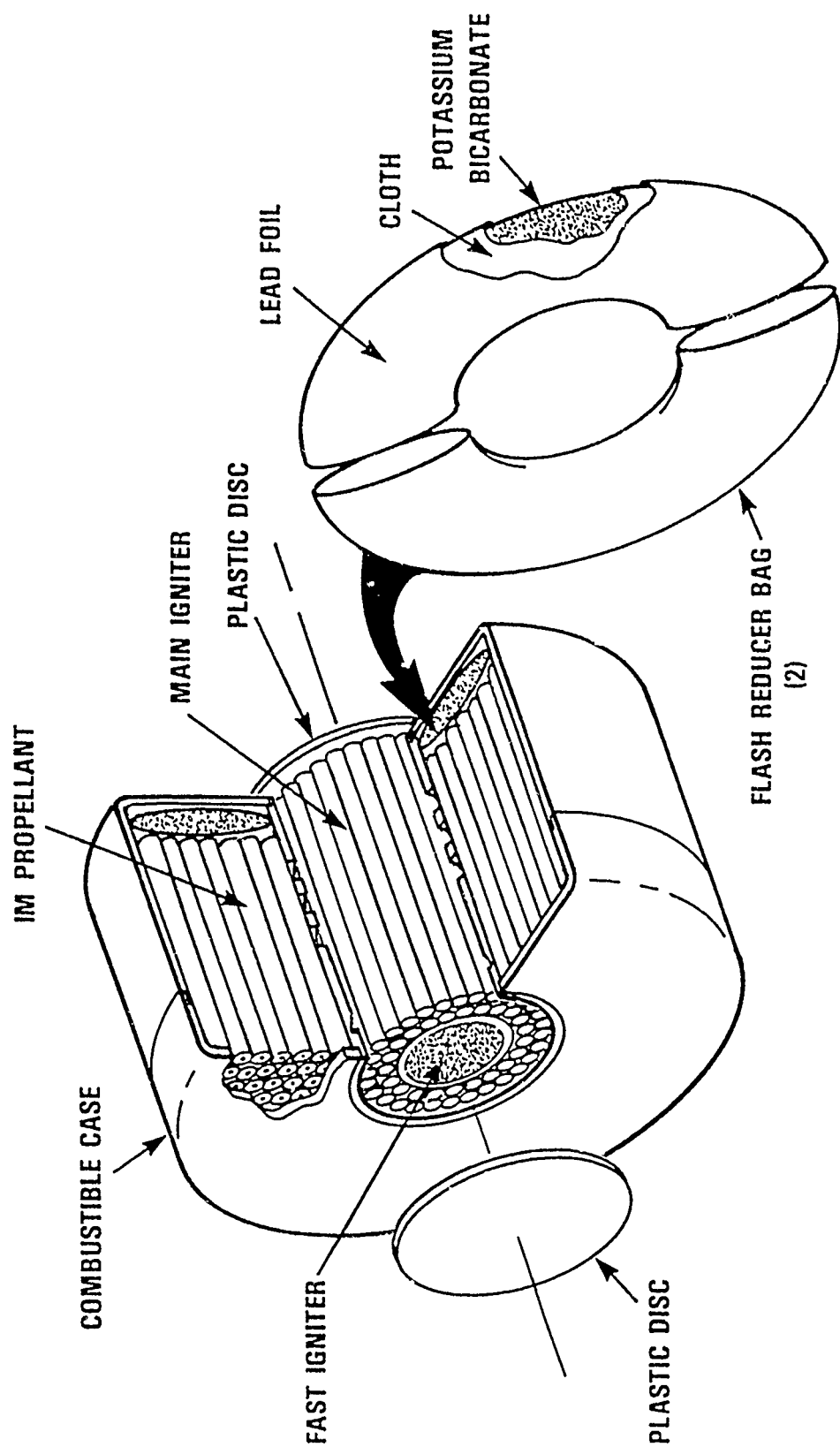
# 45MM APFSDS-T Cartridge



## Characteristics

- LENGTH: 12.0 IN
- DIAMETER: 2.75 IN
- WEIGHT: 7.02 LBS
- PENETRATOR DIA: 523 IN
- PENETRATOR L/D: 14
- PENETRATOR WT: 454 gm
- PROJECTILE WT: 748 gm
- PROPELLANT WT: 632 gm

# Unicharge



# INSENSITIVE PROPELLANT

## Future Plans

### Unicharge

- Perform Ballistics And IM Tests
- Select Two Best Candidates
- Propulsion Decision Demo - June 91

### COMVAT

- Continue Ballistic Tailoring
- Conduct IM/ Vulnerability Tests

### M919

- Conduct BFV Mock-Up Vulnerability Tests
- Conduct Final Ballistic Test On Downselected Candidates
- Phase Best Candidate Into FSD October 90

### ATAC

- Manufacture And Ship Propellant Samples To BRL For Vulnerability Screening Tests Together With Other ATACS Candidates
- Conduct Shaped Charge Jet And Spall Impact Tests At ARDEC

# INSENSITIVE PROPELLANTS *Future Plans*

	FY90	FY91	FY92	FY93	FY94	FY95	FY96
<b>GENERIC R&amp;D</b>							
	6.1 AND 6.2						
<b>BRADLEY, 25MM</b>							
M919 (IM)	6.3A	6.4		$\Delta_{TC}$			
<b>TANK</b>	NS						
XM900E1	$\Delta_{TCLP}$	$\Delta_{TC}$					
ATAC		LRIP	PRODUCTION				
		6.3A					
120MM (AEI)		$\Delta_{TC}$	PRODUCTION				
<b>COMVAT</b>		6.2					
AFAS, UNICHARGE	6.3A		FSD				
		NS					
6.1/6.2/6.3A (\$M)	3	3	3	3	4	4	4

# ***Challenge To Industry***

- **Formulate Less Sensitive Energetic Plasticizers And Binders**
  - Provide Low Vulnerability Characteristics
  - Meet Performance Requirements
  - New Liquid Nitramines And Thermoplastic Elastomers Required
- **Develop Threat Simulation Tests And Predictive Models**
  - Low Cost/Small Scale Vulnerability Tests Which Correlate To Threats
  - Develop Models Of Munition Response To Threat
- **Improve Processing Technology**
  - New Manufacturing Techniques For Less Sensitive Ingredients
  - Continuous Insensitive Propellant Process Technology Development
  - Ammunition Production For Tank, BFV, Artillery

# INSENSITIVE MUNITIONS

## *Summary*

### *Project Summary*

- There Is A Major Effort By The Army To Improve Survivability Of Weapons And Develop Insensitive Munitions
- Technology Programs Underway On Unicharge, M919, Anti-Armor Warheads, Insensitive Propellants And Explosives

### *Industrial Participation Needed In The Following Areas*

- Technology Challenges
  - High Energy, Low Vulnerability Materials And Formulations
  - Vulnerability Diagnostics
- Production Challenges
  - Ingredient Manufacture
  - Propellant And Ammunition Manufacture
  - Continuous Process Development

**Advanced  
Planning  
Briefing for  
Industry**

**DECADE OF  
CHANGE  
90'S**



**Armament Challenges for  
the 1990's . . .**

# ***Fire Control- Battlefield Management***

**PRESENTED BY**

**EUGENE DEL COCO**

**FIRE SUPPORT ARMAMENTS CENTER  
724-6021**



# ***Outline***

- What Is Fire Control Battlefield MGMT?
- Program Overview
- Program Focus
- Status
- Plans
- Challenge To Industry
- Summary

# Program Overview

<p><u>Objectives</u></p> <ul style="list-style-type: none"><li>● Increase Quality And Timeliness Of Decision Making</li><li>● Decrease Training Lead Time</li><li>● Reduce Logistics And O&amp;O Costs</li><li>● Improve Indirect Fire Control For "Light" Fire Support Weapons</li></ul>	<p><u>Technology Barriers</u></p> <ul style="list-style-type: none"><li>● On -Board Application Of Artificial Intelligence (AI)</li><li>● Signal Processing Capability For Expert Systems</li><li>● Distributed Multi - Platform Decision Support Technology</li><li>● Low - Cost Position Location, Orientation And Laying Systems</li></ul>
<p><u>Needed Technology</u></p> <ul style="list-style-type: none"><li>● Embedded Real Time Expert Systems</li><li>● Sensor/Information Fusion Technology</li><li>● Lightweight, Rugged And Accurate Position Location, Orientation And Weapon Laying Sensors</li></ul>	<p><u>Payoffs</u></p> <ul style="list-style-type: none"><li>● Reduced Weapon System Crew Size, Work Load, And Stress</li><li>● Reduced Response Time</li><li>● Improved Accuracy</li></ul>

# **Program Focus**

## **Technology Applications**

- **Advanced Fire Control System For  
Light Fire Support Weapons**
- **Advanced Crew Station Fire Control**

# ***What Is Fire Control Battlefield Management ?***

- Planning, Directing, Controlling, Integrating  
And Operating The Complete Fire Control  
Process To Effect A Target Hit

## ***Why Is It Necessary ?***

- Improve Accuracy, Reduce Response Time,  
Reduce Crew Size, Reduce Crew Stress And  
Work Load

# **Advanced Fire Control System For Light Fire Support Weapons**

## **Status**

- Concept Successfully Demonstrated
- Concept Refined, Improved, And User Interest Generated
- Developing Plans For Advanced Test Bed - On Going

## **Technical Plans**

- Integrate Technology Advances From Expansion Of GPS Market, Improved Compass Technology & Improved Micro - Computers And Digital
- Demonstrate Fully Integrated System In 1991

# **Advanced Crew Station Technology**

## **Status**

- Completed Concept Definition And Validation
- System Architecture Developed
- Developing Lab Prototype - On Going
- Developing Concepts For Vehicle Mounted Test Bed - On Going

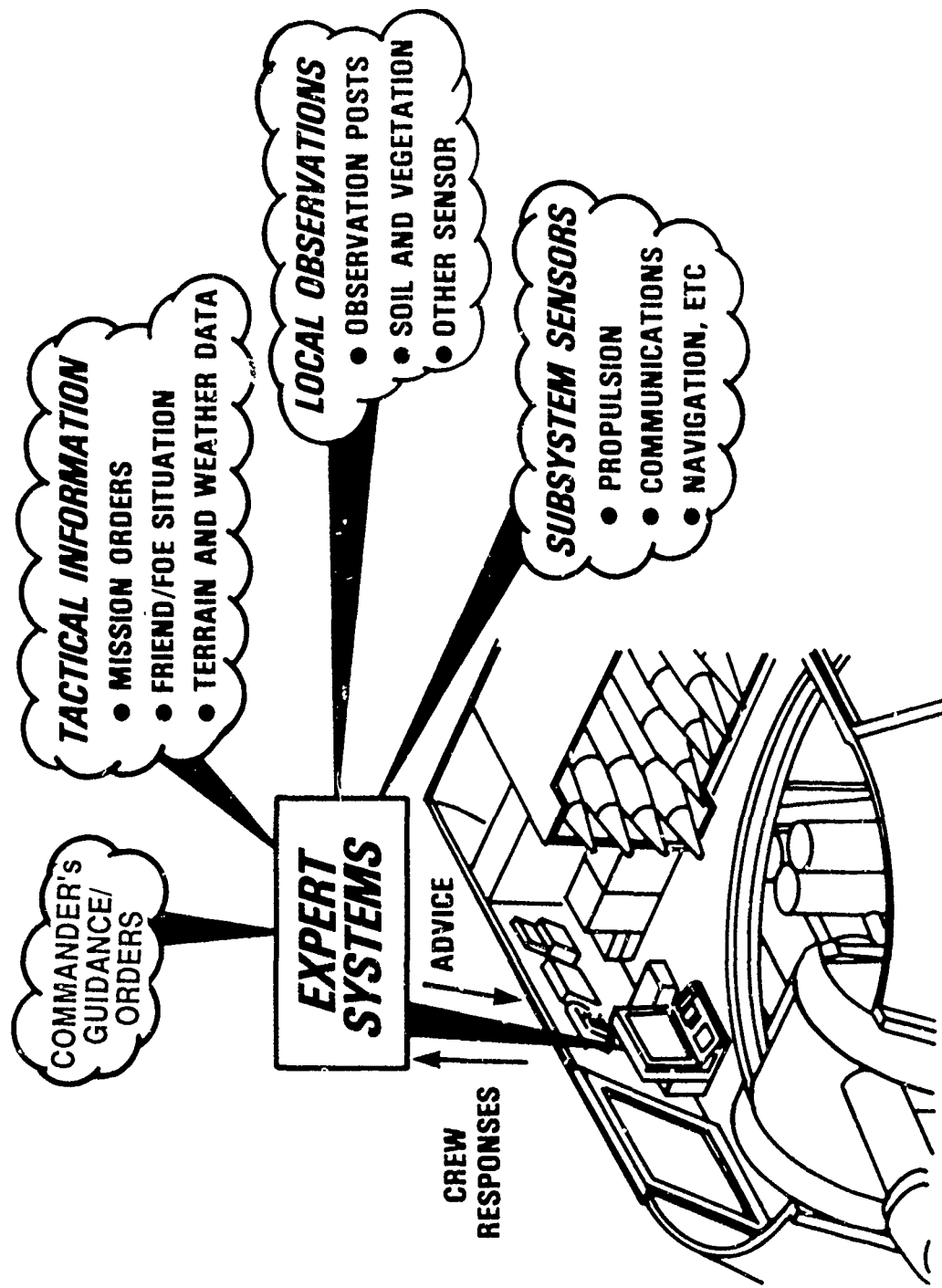
## **Technical Plans**

- Develop Laboratory Prototype Systems In 1992
- Configure System For Test Bed, Evaluate And Conduct Tech Demo In 1994

# --- --- **Program Plans** --- ---

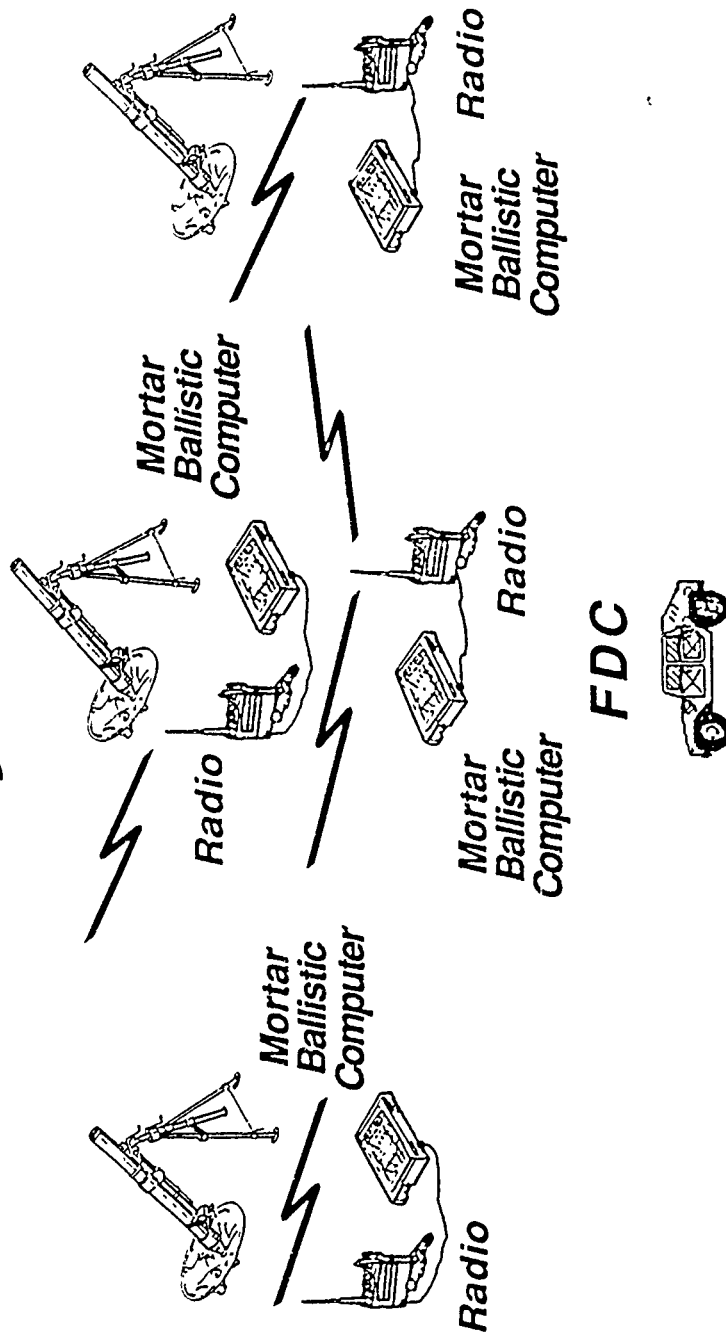
<i>Program Element</i>	1990	1991	1992	1993	1994	1995
Advanced Fire Control	6.3a	6.3b	6.4		PROCUREMENT	
Advanced Crew Station Technology	Concept Development 6.2		LAB TEST 6.2	Test Bed Evaluation 6.2		6.3
Funding	\$0.8M	\$2.0M	\$3.8M	\$3.9M	\$3.5M	\$3.0M

# Embedded AI/Expert System Technology





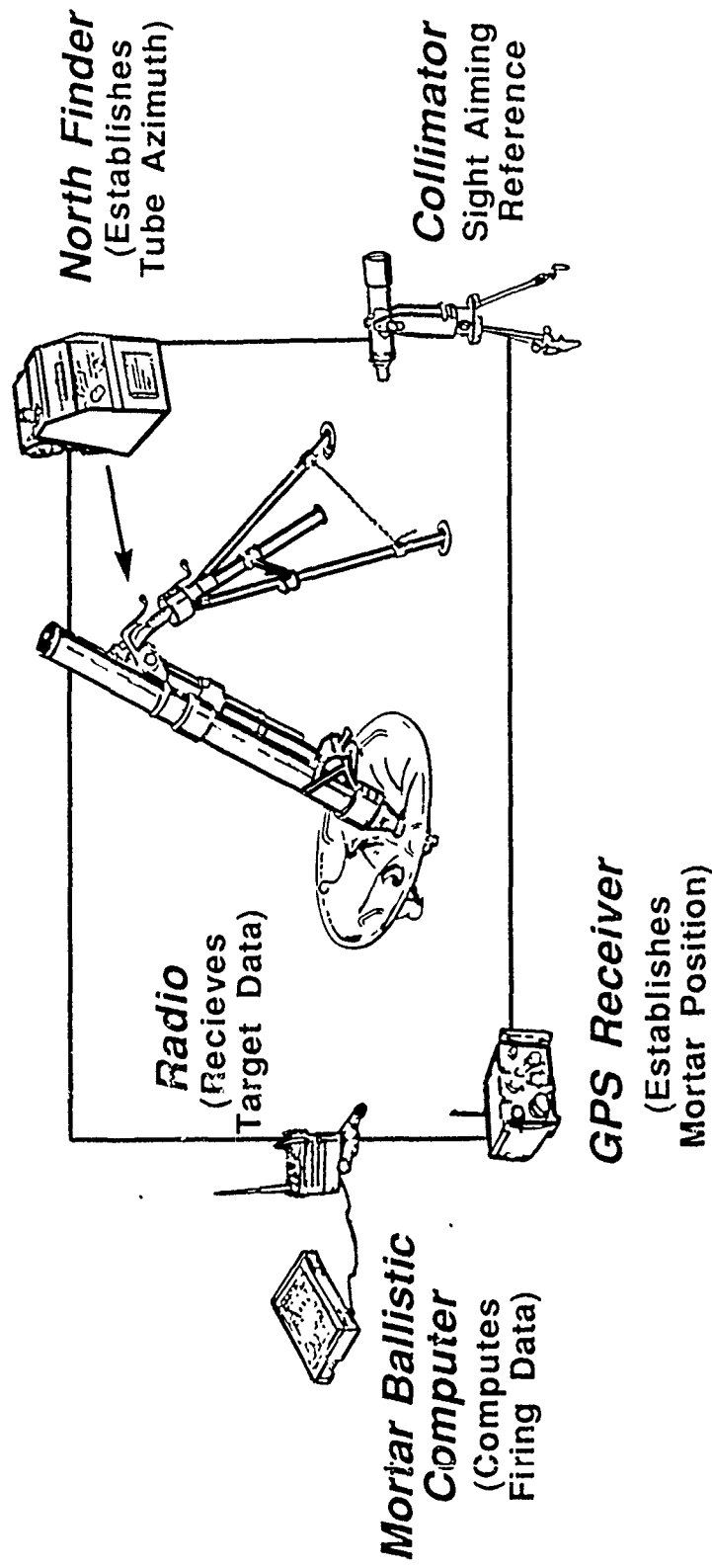
# Networking Mortar Fire Control Systems



- MORTAR AND FDC COMPUTERS LINKED BY RADIO
- MORTAR COMPUTERS ARE SLAVES TO FDC COMPUTER
- CREW ENTERS POSITION AND MOUNTING AZIMUTH DATA
- FDC SENDS TACTICAL DATA TO MORTARS
- MORTARS COMPUTE FIRING DATA , REPORT STATUS TO FDC

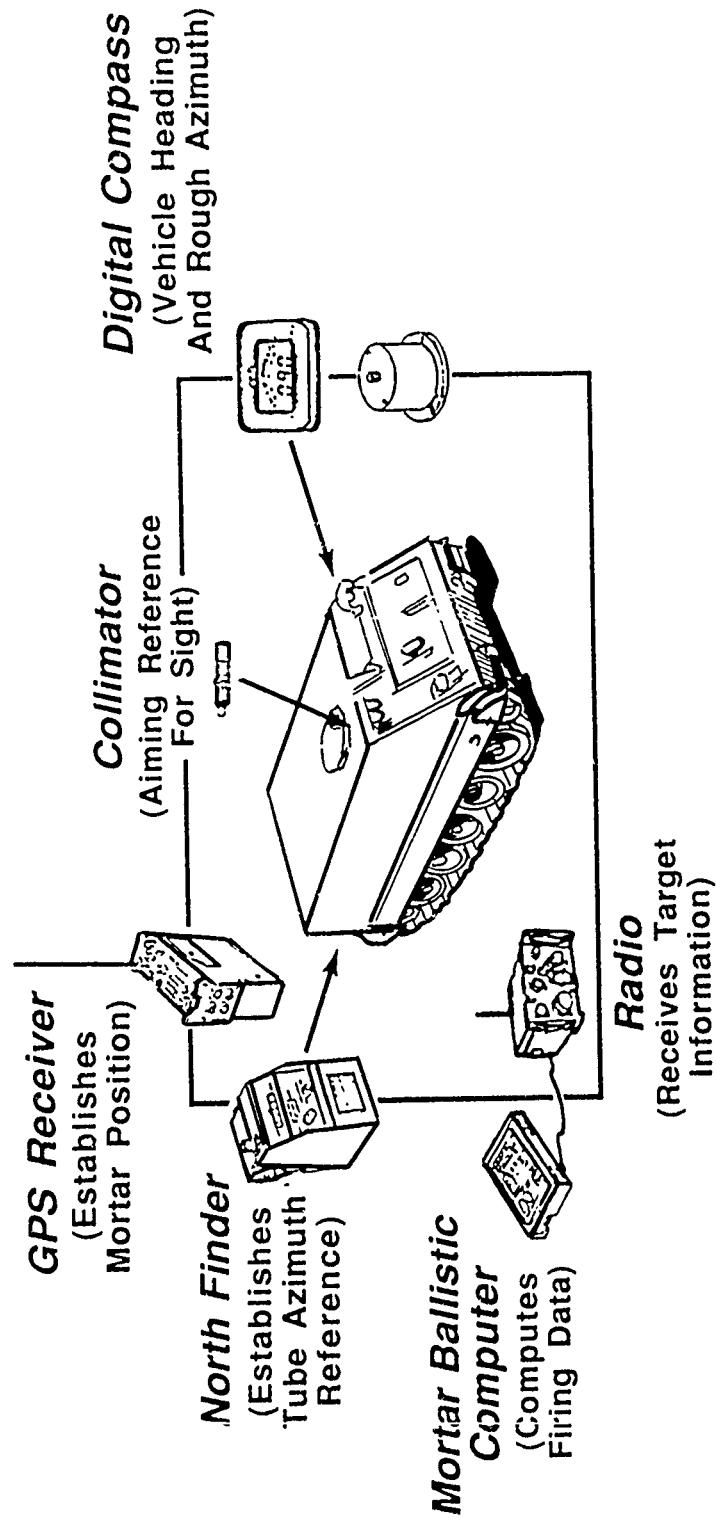
# Advanced Fire Control System For Fire Support Weapons

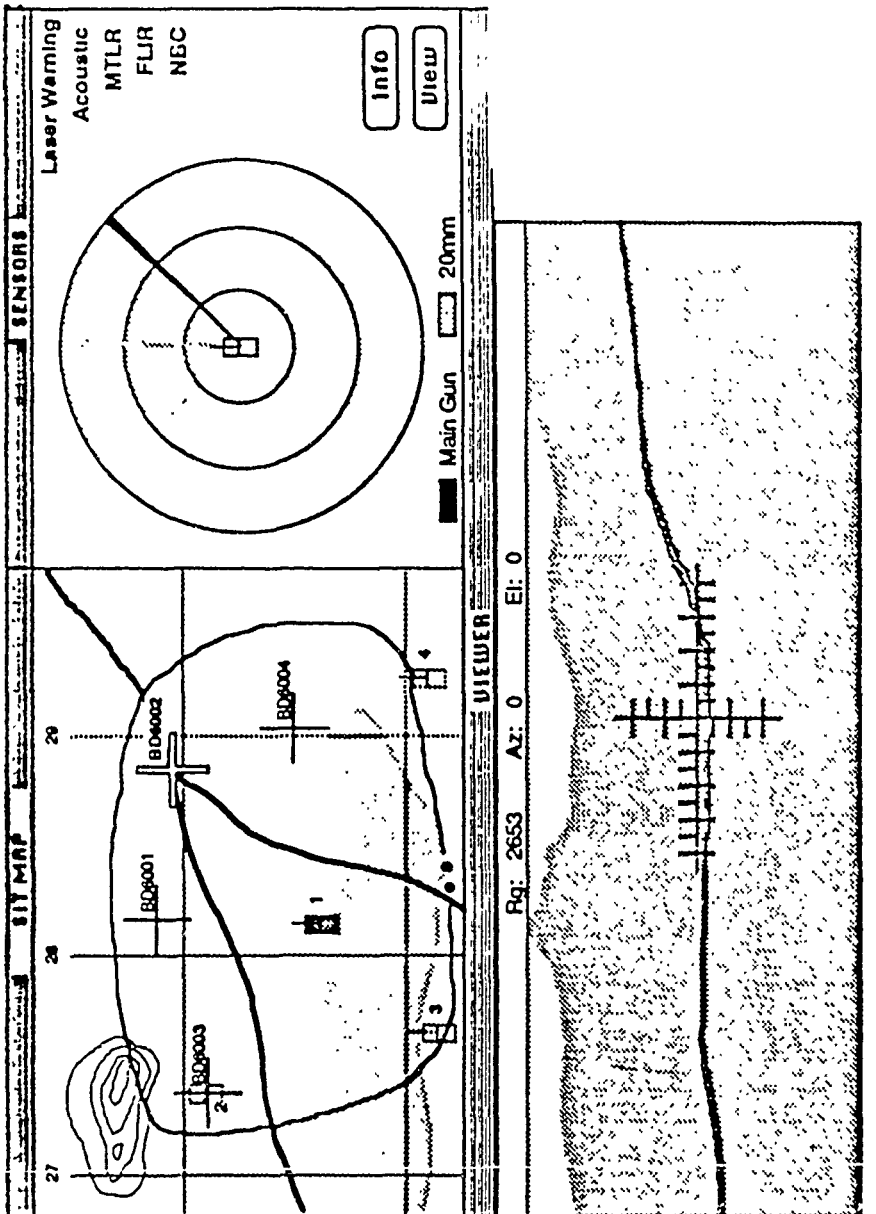
## Ground Mortar Application



ADVANCED FIRE CONTROL SYSTEM FOR FIRE SUPPORT WEAPONS

# Self Propelled Mortar Application





System Status

Autonomous

Weapons

Sensors

Supply Status

POL

Rations

Water

Ammunition Status

Pro1

Pro2

20 ILM

Counterfire Threat

Counterfire Danger

Critical

Growing

OK

Required Action

Deploy

Plan Move

27

26

25

20

10

0

20

10

0

20

10

0

20

10

0

20

10

0

20

10

0

20

10

0

Check Firing

Current Activity

Chaff Launched

Recommended Action

Check Status

Execute

Defend

Call for Fire

Engage Main

Fire 20mm

End of Msn

Occupy & Displace

Emplace

Move

March Order

Emerg. Move

Abort

Chaff

Smoke

Shell Report

Received Messages

View

Delete

Zoom In

Track

Zoom Out

Sweep

Loze

Select Tgt

Align Tube

Align 20mm

Cancel

Info

View

20mm

20mm

20mm

20mm

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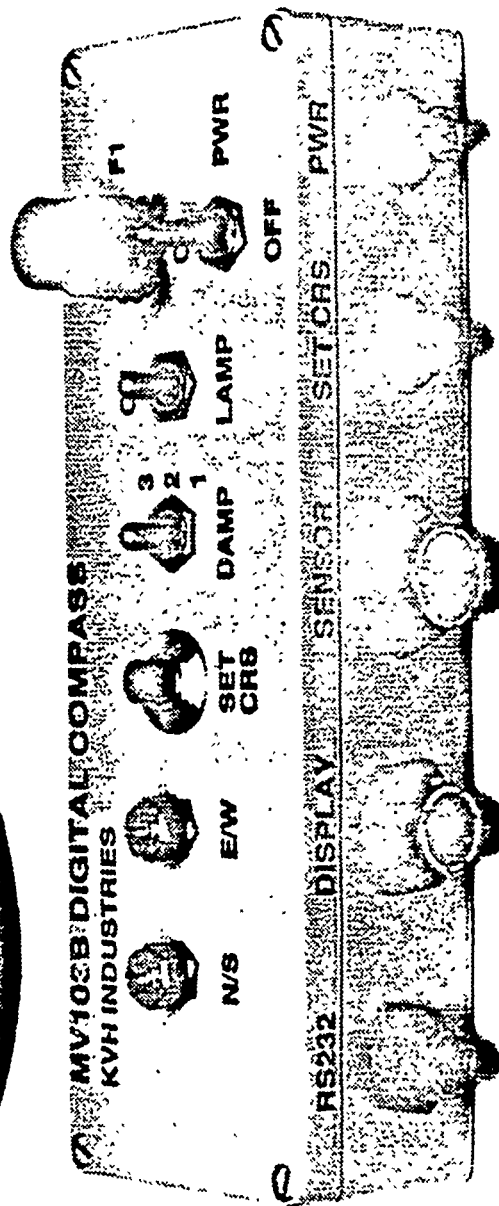
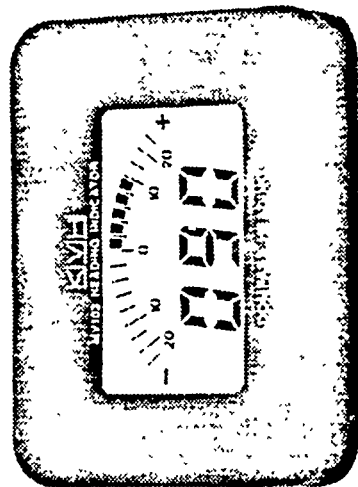
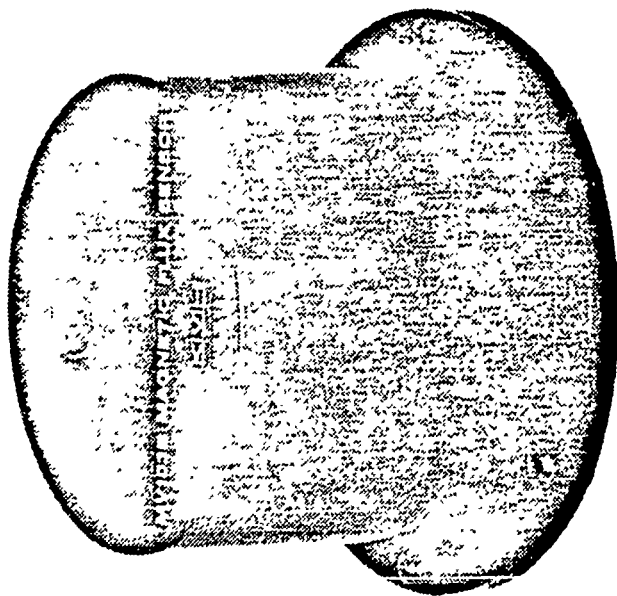
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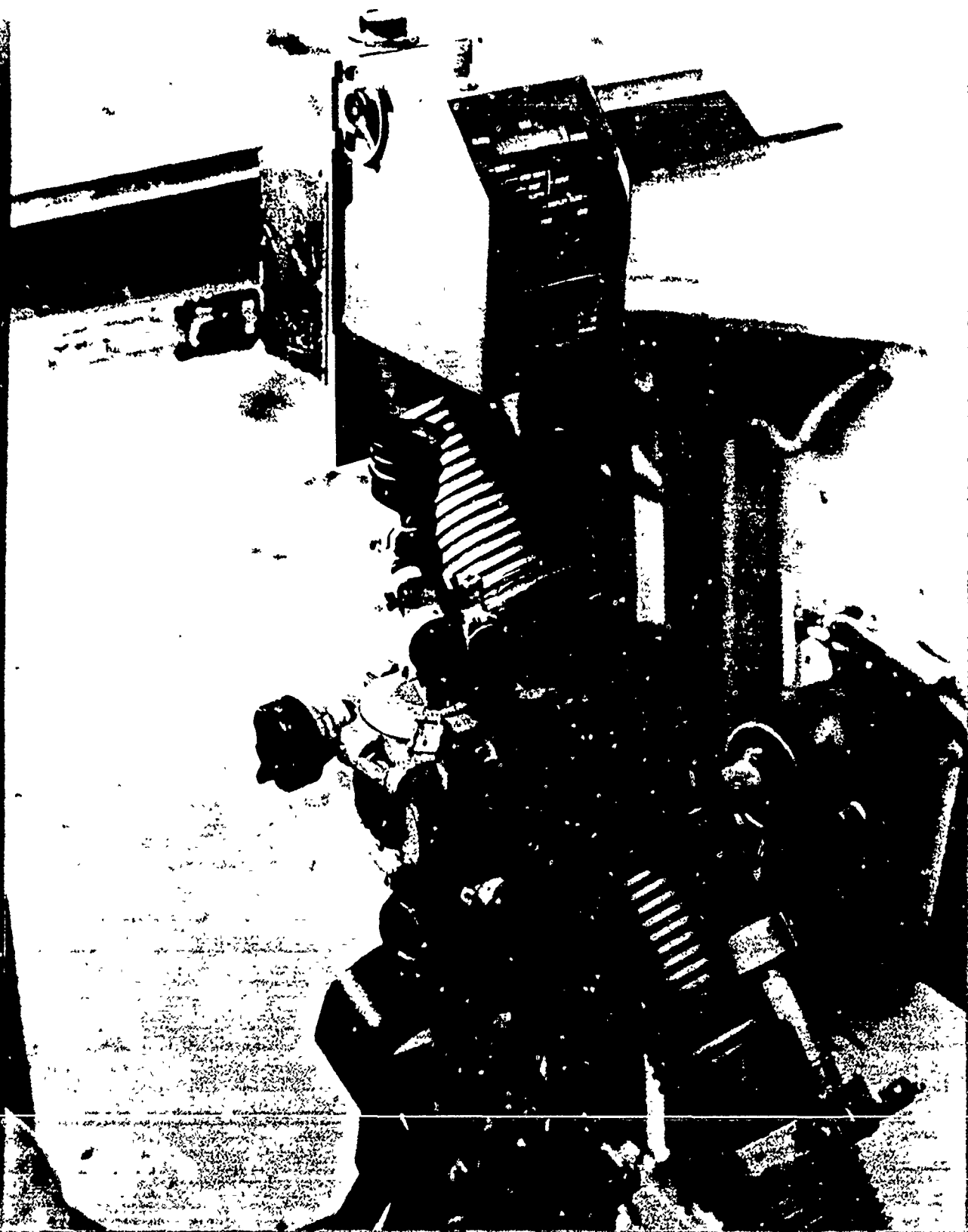
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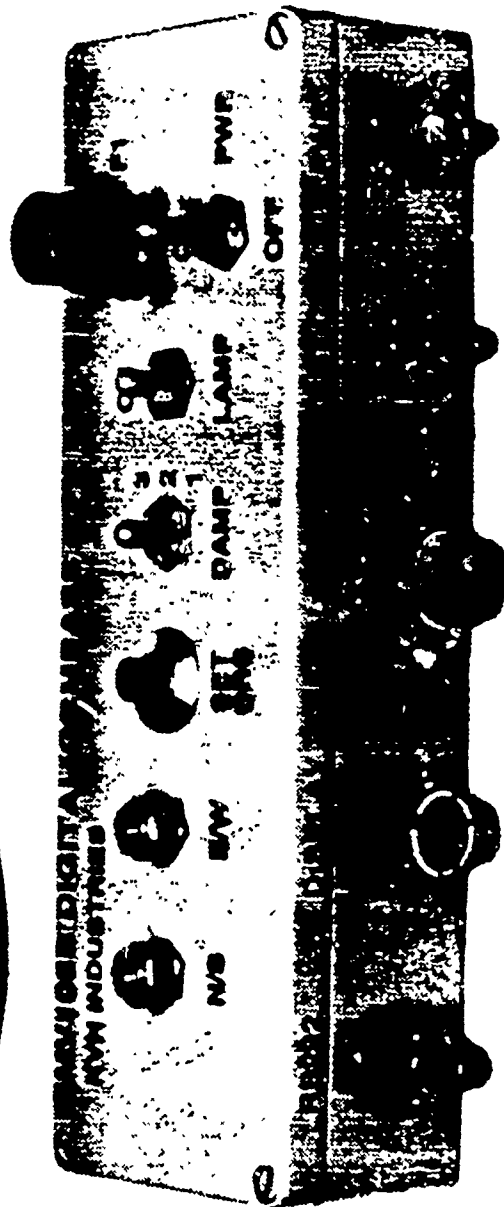
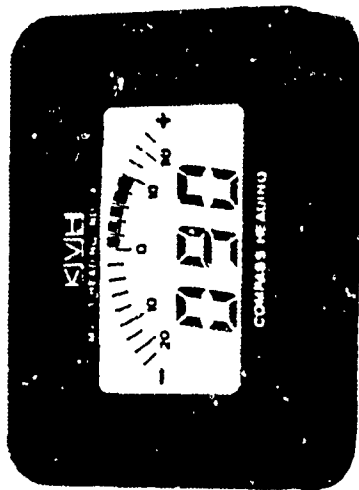
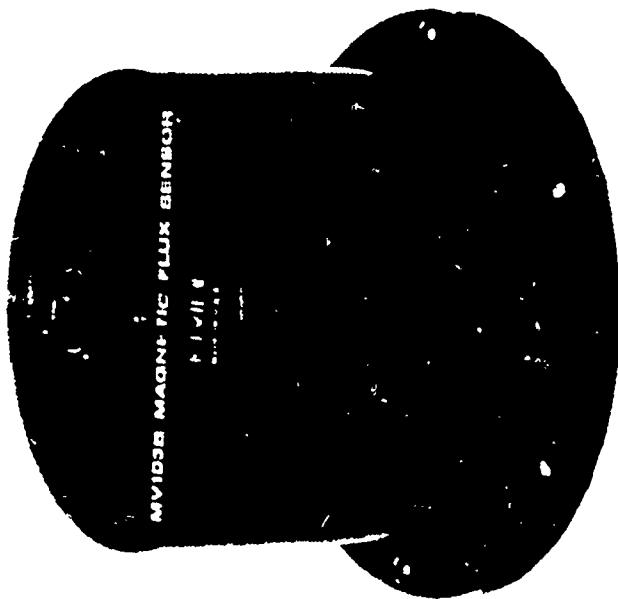






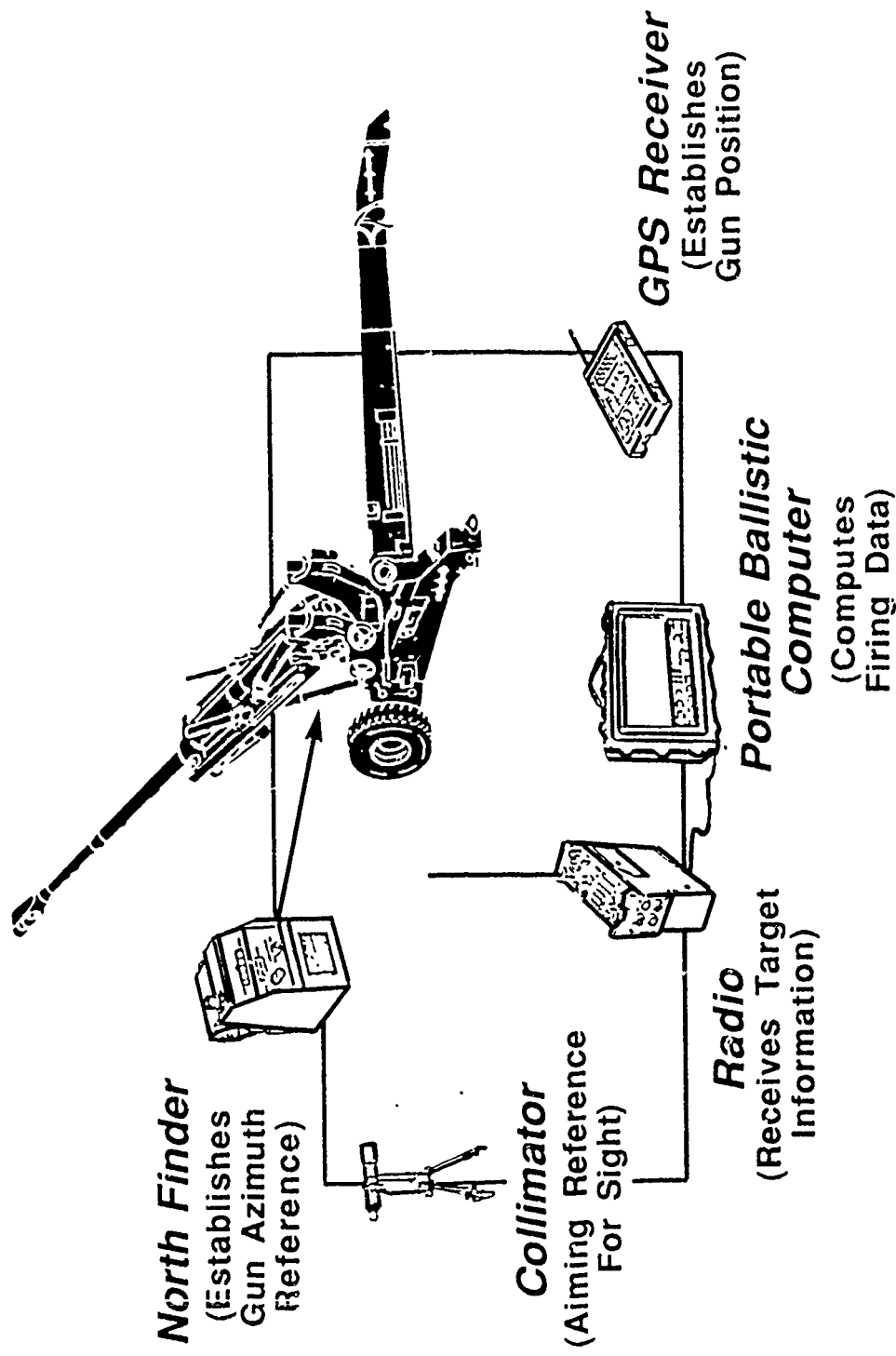






# Advanced Fire Control System For Fire Support Weapons

## Towed Artillery Application



# ***Challenge To Industry***

- Develop Real Time Distributed Expert Systems
- Develop Parallel System Architectures
- Develop Sensor Fusion Algorithm Technology
- Apply Advanced Computing Hardware Technology
- Develop Lightweight, Rugged Low Cost And More Accurate Position Location, Orientation Computation And Digital Communication Interface

# Summary

## Project Summary

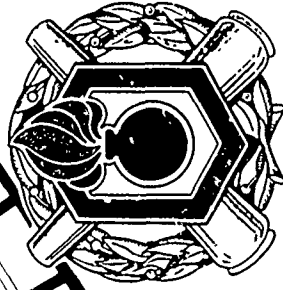
- Advanced Fire Control System Concept Established
- Crew Station Technology Defined And Validated

## Industry Participation Needed In Following Areas

- Develop Smaller, Lighter, More Affordable System Components For Advanced Fire Control Systems
- Integrate Artificial Intelligence Technology
- Apply Advanced Computing Technology

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**Armament Challenges for  
the 1990's . . .**

# **Smart Munitions Programs**

**PRESENTED BY**

**ROBERT REISMAN**

**FIRE SUPPORT ARMAMENTS CENTER  
724-3116**

# ***Outline***

- What Are Smart Munitions
- Program Overview
- Program Focus
- Status
- Plans
- Smart Munition Is A Viable Business
- Challenges To Industry
- Summary



# **== What Are Smart Munitions ? ==**

- Projectiles Containing A Sensor Or Seeker That Can Detect A Target

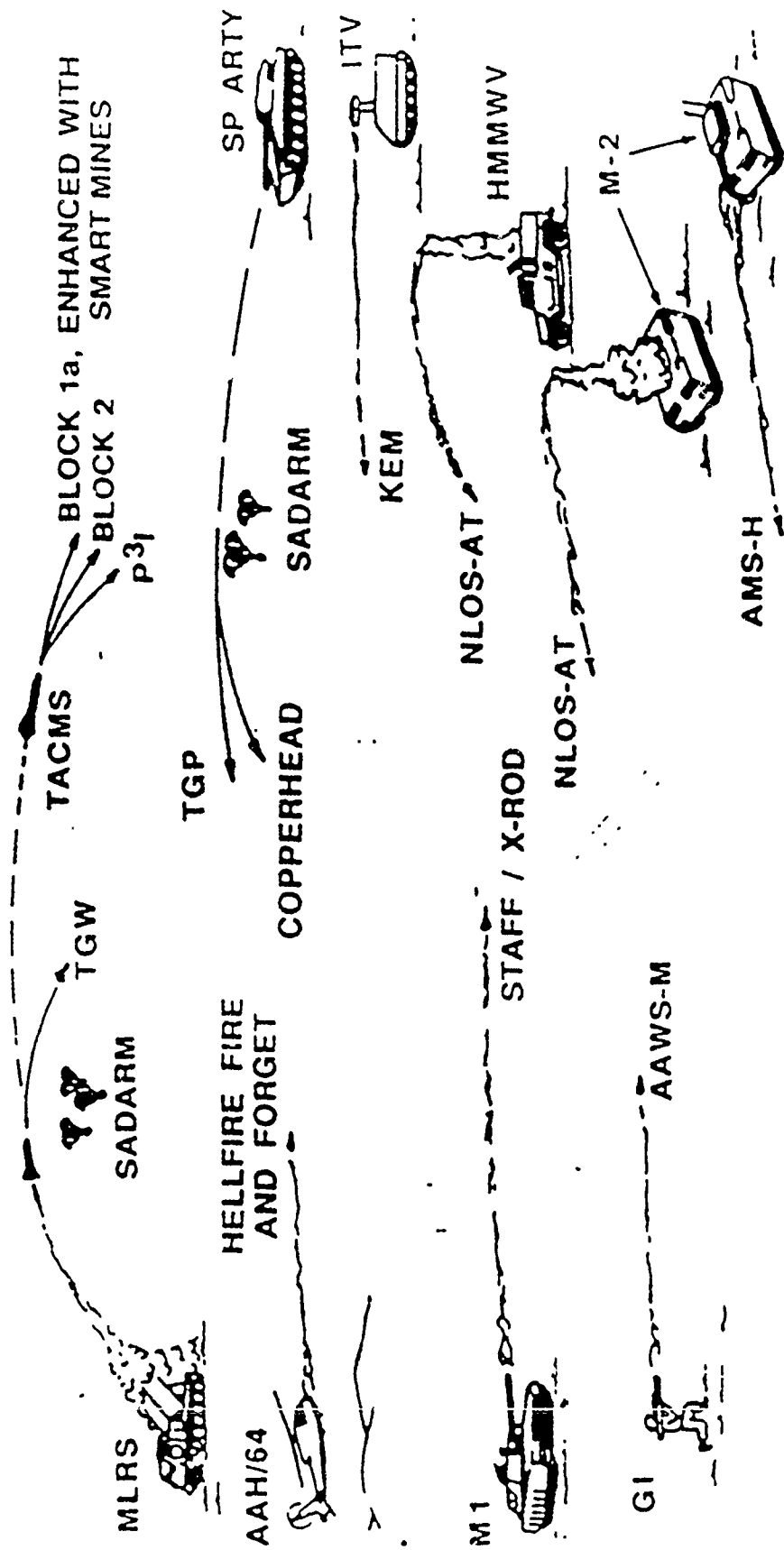
- Either By Guiding To The Target (Hit To Kill)

**OR**

- Directing A Warhead At The Target (Shoot To Kill)

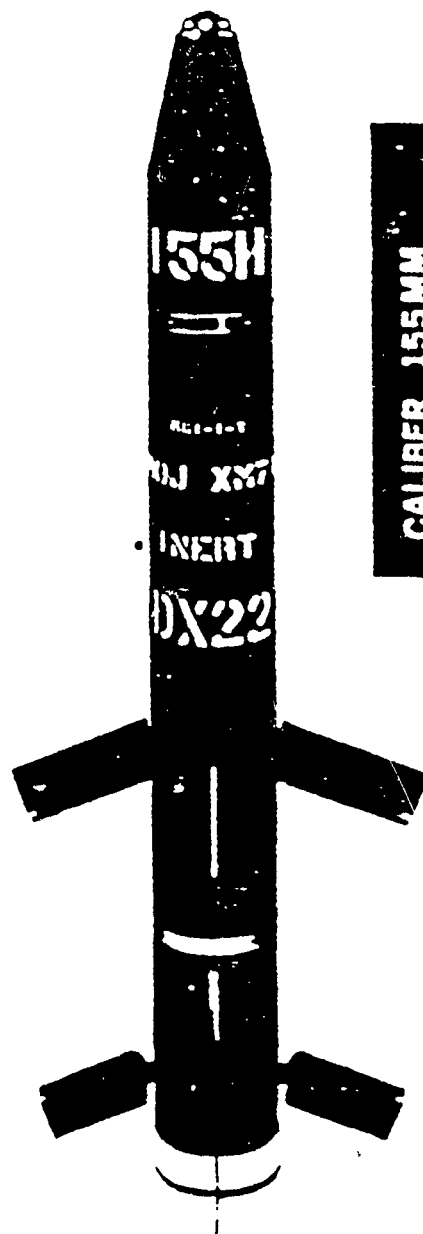
- Provides Highly Accurate Fire Against Point Targets  
(10 To 100 Times Increase In Kills Over Conventional Rounds)

# *(U) The Smart Munition Weapon Candidates For The 1990's*

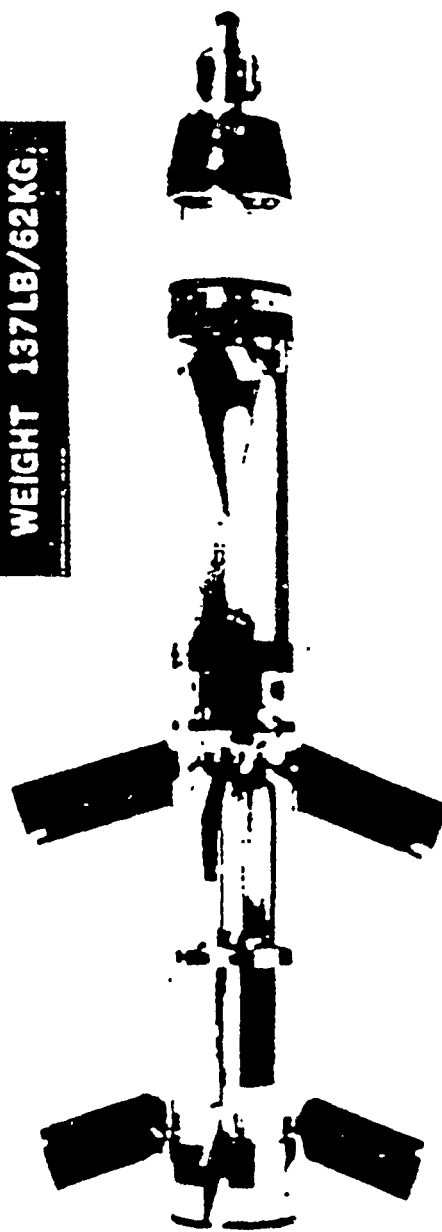




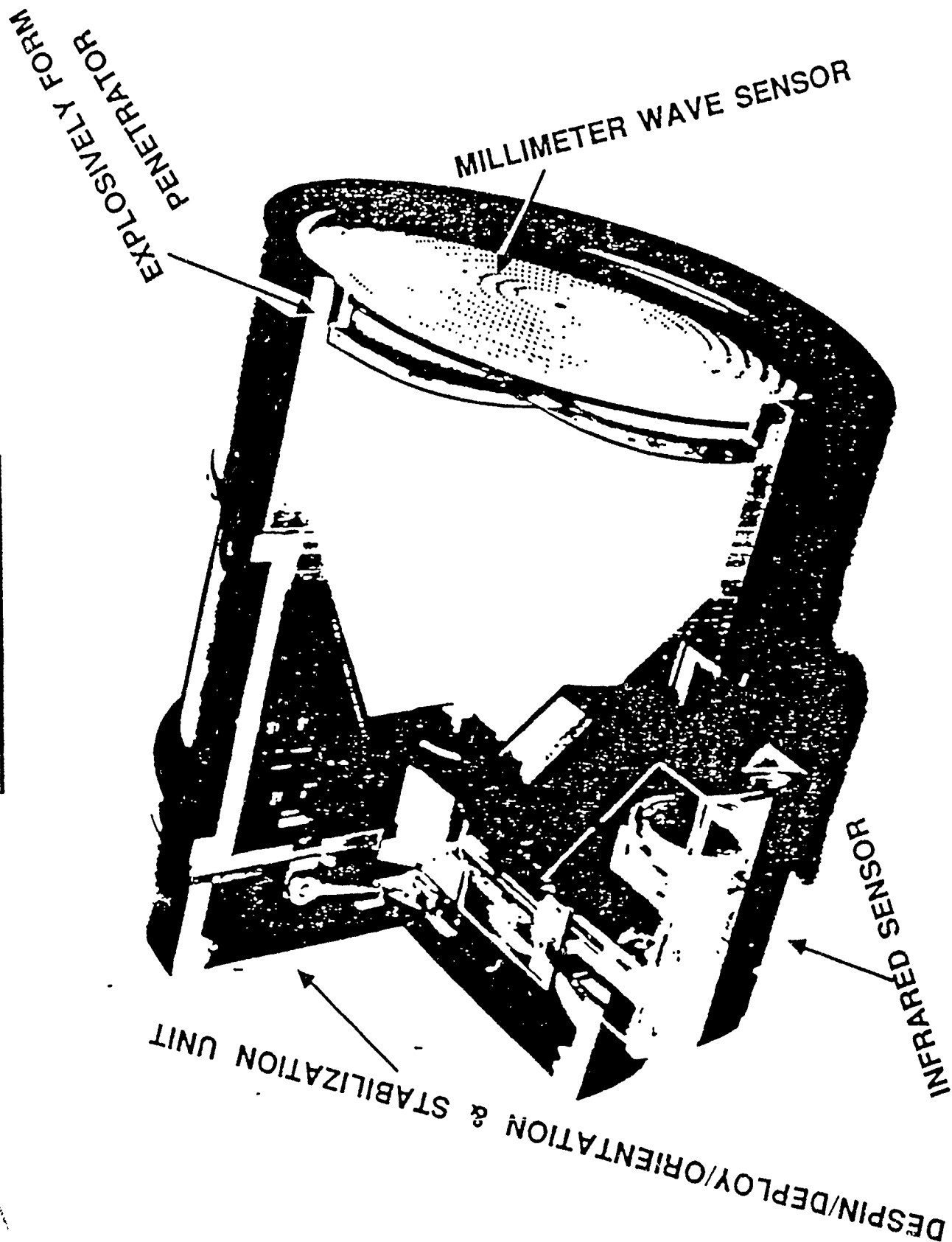
# COPPERHEAD



CALIBER 155MM  
LENGTH 54IN/137CM  
WEIGHT 137LB/62KG

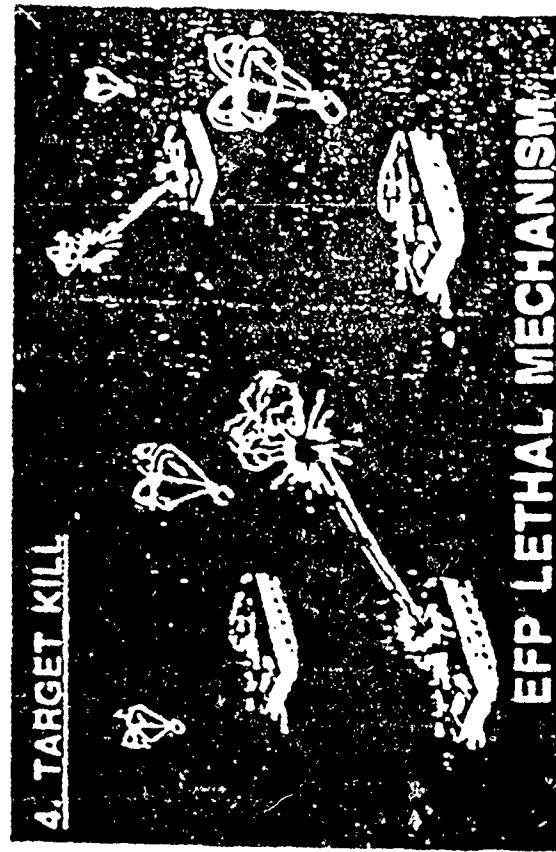
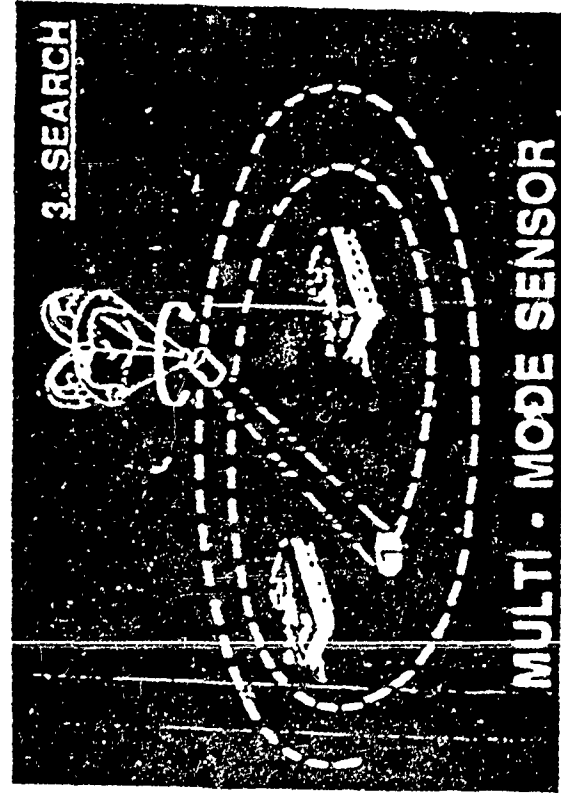
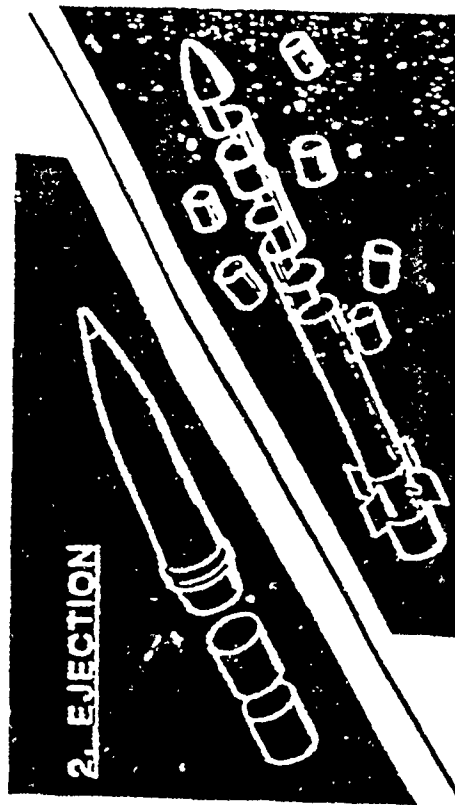
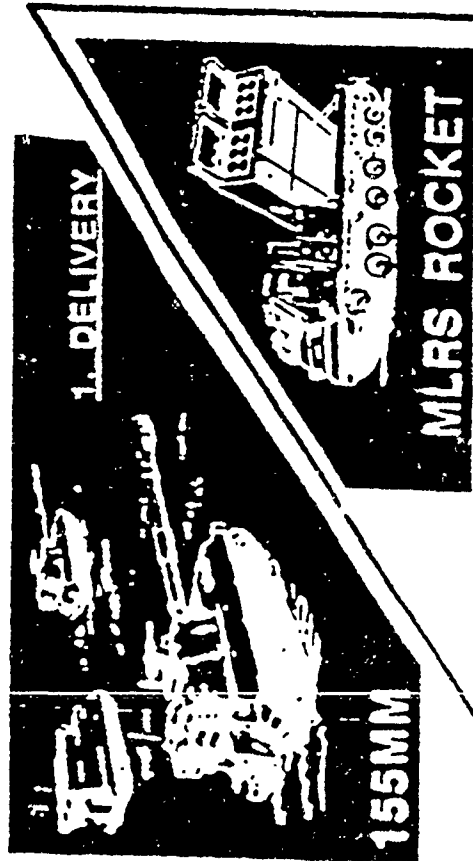


# SADARM

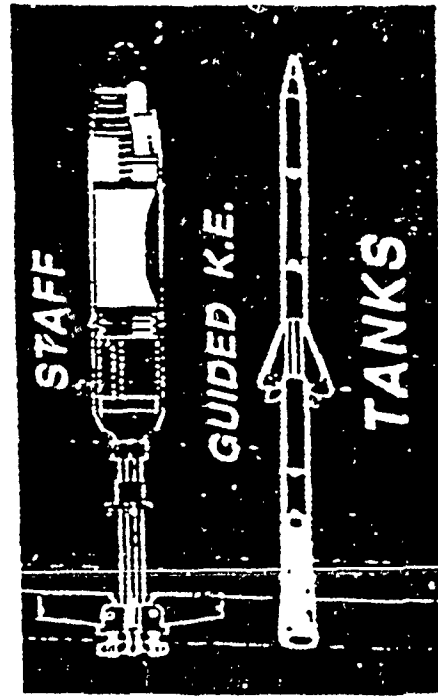
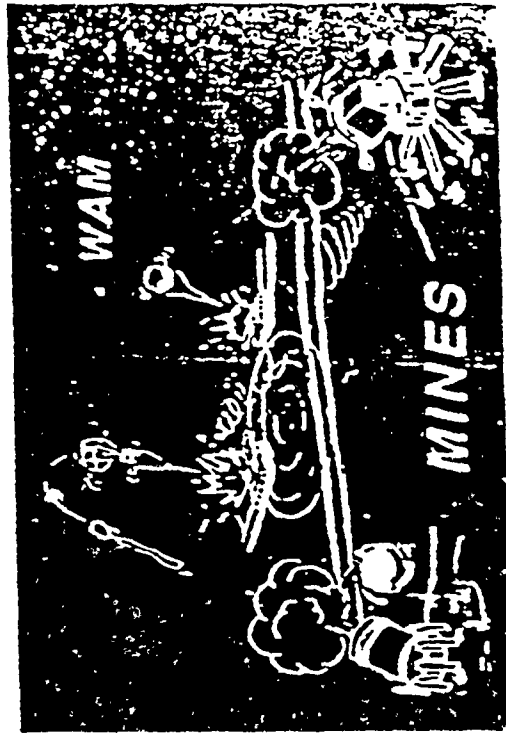
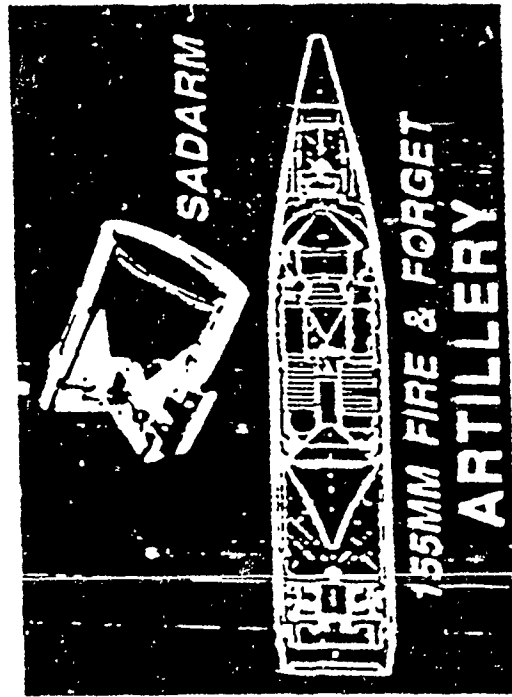


# SADARM Operational Concept

COUNTER - BATTERY



# Smart Munition Programs



# Program Overview

<p><u>Objective</u></p> <ul style="list-style-type: none"> <li>● Develop Submunition To Autonomously Reach Targets</li> <li>● Defeat Chosen Targets With Limited Number Of Rounds</li> <li>● Design To Be Fired From A Number Of Systems               <ul style="list-style-type: none"> <li>● Howitzers</li> <li>● Mortars Are Potential Systems</li> <li>● Mines</li> <li>● Tanks</li> <li>● Aircraft Gun</li> </ul> </li> </ul>	<p><u>Technology Barriers</u></p> <ul style="list-style-type: none"> <li>● COST</li> <li>● Sensing Targets In Cluttered Background</li> <li>● Defeat Of Non Vehicular Targets (MOUT)</li> <li>● Defeat Improved Armor</li> <li>● Versatility               <ul style="list-style-type: none"> <li>● Same Projectile Defeat Tank/Helicopter</li> <li>● Same Projectile Defeat Armor &amp; Non Vehicular Targets (MOUT)</li> </ul> </li> </ul>
<p><u>Needed Technology</u></p> <ul style="list-style-type: none"> <li>● Low Cost Sensor/Seeker</li> <li>● Dual Mode Seeker</li> <li>● Lightweight Warheads</li> <li>● Miniaturized Packaging Of Electronics</li> <li>● Low Cost Systems</li> </ul>	<p><u>Payoffs</u></p> <ul style="list-style-type: none"> <li>● Reduced Logistics Burde</li> <li>● High Priority Kills</li> <li>● Affordable Munition Systems</li> <li>● Surgical Kills</li> </ul>

# ***Program Focus***

- Gun Fired Smart Munition That Is Comparable With Evolving Threat (Evolving Threat Discussed On Next 2 View Graphs)
- Develop Technologies That Can Make Smart Munition More Affordable
  - Millimeter Integrated Circuits
  - Laser Radar
  - Low Cost Suspension System
  - Low Cost Warheads
- Develop Technology That Makes Smart Munition More Countermeasures Resistant
- Warhead Technologies That Can Defeat The Most Advanced Threat



# ***Evolving Threat***

	<i>MBT</i>	<i>Lt Tank</i>	<i>IFV/APC</i>	<i>Artillery</i>	<i>Mortars</i>	<i>MLRS</i>
<i>FIRING PLATFORMS</i> (U.S. & Allies)	36,151	1,426	71,687	19,494	18,992	747
<i>TARGETS</i> (Soviet & Eurasian Asian Communist)	94,350	1,363	80,520	42,679	20,207	8,953
<i>PLATFORMS/TARGETS</i> (Less Developed Countries)	47,801	4,797	60,171	50,778	34,107	8,752

- MBT - Main Battle Tank
- Lt - Light
- IFV/APC - Infantry Fighting Vehicle/Armor Personnel Carrier
- MLRS - Multi-Launch Rocket System

# ***Limited Airlift Capability Dictates Use Of Smart Munitions***

## **VEHICLE KILLS/C141 LOAD**

<b><i>Ammunition</i></b>	<b><i>Conventional</i></b>	<b><i>Smart</i></b>	<b><i>Future Smart</i></b>
<b>155MM AMMO</b>	<b>4.5</b>	<b>45</b>	<b>90</b>

## **WEAPON SYSTEM DELIVERY BY AIR**

<b><i>Weapon</i></b>	<b><i>C130</i></b>	<b><i>C141</i></b>	<b><i>C-5A</i></b>	<b><i>C17</i></b>
<b>155MM TOWED</b>	<b>1</b>	<b>1</b>	<b>8</b>	<b>4</b>

# Status

## Technology

- Current Full Scale Development
  - SADARM
  - WAM
  - STAFF
- Studies On Autonomous Gun Fired SEEKER Demonstrated Program Being Initiated
- Technology For Tank Fired Guided Munition Continuing

## Plans

- Full & Open Competition For Gun Fired SEEKER Demonstration Program To Be Awarded In FY91
- Technology For Pre-Planned Product Improvement Program For SADARM Is Required
- Industry IR&D Program Should Exploit Lightweight Guided Munition
- Industry IR&D Program Should Exploit Low Cost SEEKER

# Plans

	90	91	92	93	94	95	96	97
SADARM	DEVELOPMENT				PRODUCTION			
*SEEKER Demo Program	SEEKER TECHNOLOGY				POP	GUIDED PROJECTILE DEVELOPMENT		
Tank Fired Guided Munition	POP				DEVELOPMENT			
Infantry					DIRECT FIRE DEVELOPMENT (RECOILESS RIFLES)			
• SEEKERS	TECHNOLOGY							
• Warhead	WARHEAD							
• Lightweight Gun Technology	GUNS							
Total Funding (\$M)	250	200	300	260	150	100	250	250

\* NEW STARTS

# ***Smart Munition Is A Viable Business @ ARDEC***

- Small Investments In Smart Munitions Alone Yields Extreme Force Multipliers
- Versatility In Various Theaters (Mid/Low Intensity)
- Technology For Lightweight/Easily Transportable Systems Are Here But "*UNTAPPED*"
- Producibility Culture At ARDEC Is Crucial For Future Smart Munitions

# ***Challenge To Industry***

## ***Affordable Smart Munitions***

- Solid State Sensors
- Simple Suspension Systems
- Millimeter Integrated Circuits
- Advanced Electronic Packaging
- Automated Assembly

## ***Lightweight Munition - Easily Transportable***

- Miniaturized Seekers
- High Energy/Low Weight Warheads
- Inexpensive Control Systems

## ***Versatile Munitions***

- Seekers/Sensors That Are Autonomous & Surgically Capable
- Reprogrammable (Dial The Threat)
- Seekers, Sensors & Warheads That Can Defeat Air & Ground Targets

# **Summary**

## **Project Summary**

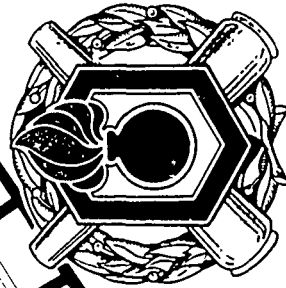
- SADARM, WAM & STAFF Scheduled For Production Mid/Late 90's
- Sensor Advancements In Cost, Countermeasures Resistance & Miniaturization Are Increasing
- Pre-Planned Product Improvements Are In Place To Improve Effectiveness & Reduce Cost
- Evolving Threat Has Placed Emphasis In Available Platforms, Versatility & Lightweight Smart Munition Systems

## **Industry Participation Needed**

- Exploit Gun Fired Smart Munitions For Evolving Threat
- Develop Affordable Sensor/Seeker Technologies
- Advance Sensor/Seeker To Acquire & Discriminate Targets In Cluttered Background

**Advanced  
Planning  
Briefing for  
Industry**

**DECADE OF  
CHANGE  
90'S**



***Armament Challenges for  
the 1990's . . .***

# ***Fire Control System for Armored System Modernization (ASM)***

PRESENTED BY

**LARRY L. YUNG**

**FIRE SUPPORT ARMAMENTS CENTER  
724-7051**



# ***Briefing Outline***

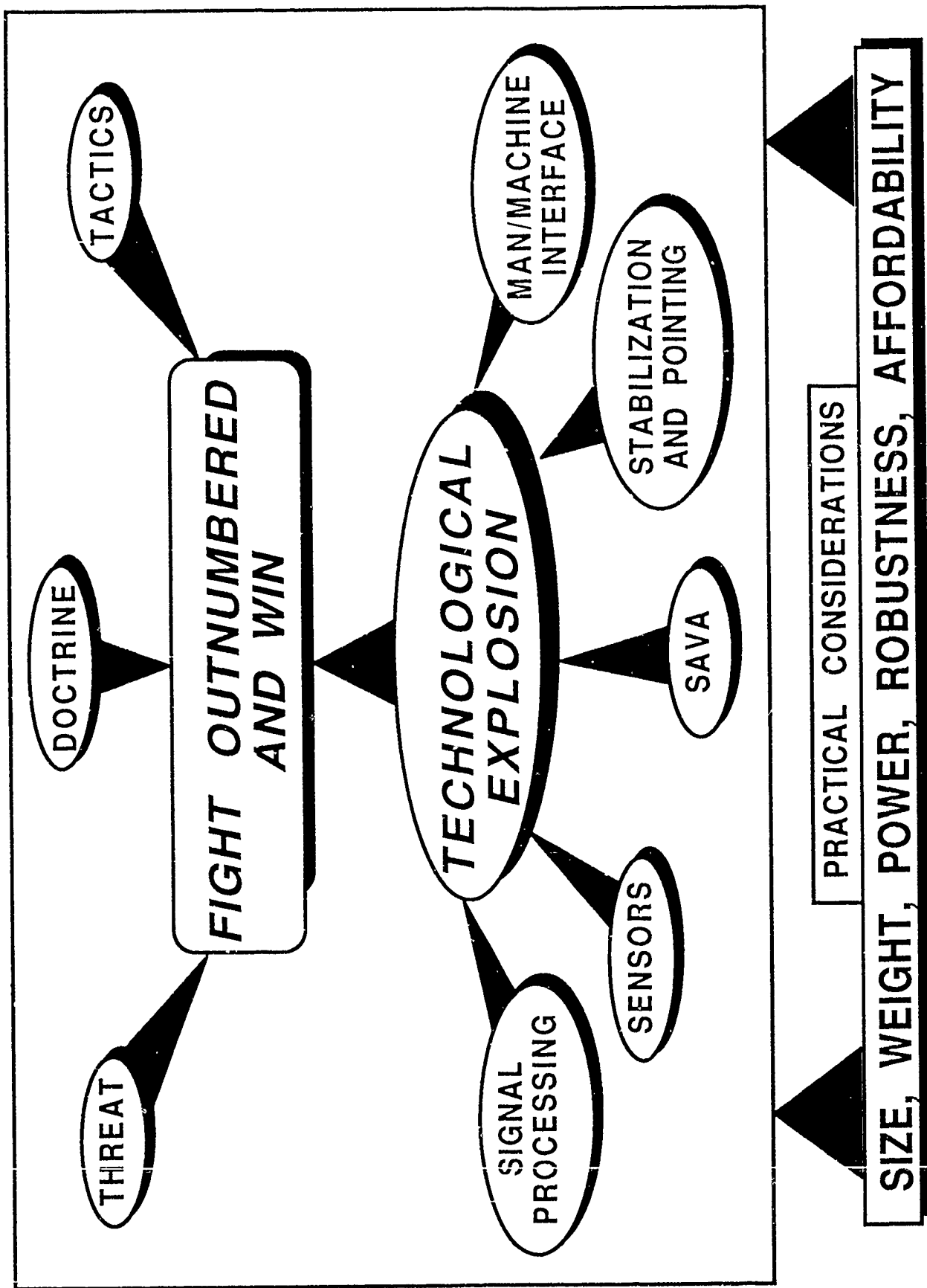
- What Is Fire Control For ASM ?
- Program Overview
- Program Focus
- Status
- Plans
- Challenge To Industry
- Summary

# **What Is Fire Control For ASM ?**

- Fire Control Is To Optimize The Probability Of Hitting A Selected Target When Launching A Projectile, While Minimizing The Time And Complexity Of Operations Required To Acquire And Fire
- Maximize The Use Of Common Fire Control Components Among The Family Of ASM Vehicles

# **== *Present Day Fire Control* ==**

- One Tank vs One Target
- Crew Intensive Operation
- Traditional Vehicle Configuration
- Limited On-The-Move Capability
- Limited All-Environment Acquisition



# **Technical Requirements For ASM**

## **Target Acquisition**

- Extend Range For Detection, Recognition, And Identification
- Reduce Acquisition Time (Single & Multiple Targets)

## **TARGET ENGAGEMENT**

- Extend Engagement Ranges
- Increase Probability Of First Round Hit At All Ranges
- Reduce Time To Hit
  - Automated Crew Tasks

## **Embedded Tactical Training**

- Gunnery/Simulation Of Engagement Scenarios

# **Program Overview**

<p><b><u>Objective:</u></b></p> <p>To Demonstrate And Validate The Long Range Fire Control Requirements For ASM (BK III, FIFV)</p>	<p><b><u>Technology Barriers:</u></b></p> <ul style="list-style-type: none"><li>● Sensor Capability</li><li>● Algorithm</li><li>● Signal Processing</li><li>● Integration</li></ul>
<p><b><u>Needed Technology:</u></b></p> <ul style="list-style-type: none"><li>● Sensor Technology</li><li>● Algorithm Development</li><li>● Processing Maturation</li><li>● Alignment Techniques</li><li>● Gun/Turret Drive Technology</li></ul>	<p><b><u>Pay Offs:</u></b></p> <ul style="list-style-type: none"><li>● Integrated All-Weather Fire Control Capability</li><li>● Improve Detection Capability</li><li>● Improve Serving Rate</li><li>● Improve Hit Probability</li></ul>

# ***Hardware/System Integration***

## ***Exist System - Limited Integration***

- From Hardware Standpoint
- From Functional Standpoint

## ***Fire Control 40% Of Vehicle Cost***

- Unique System Design
- Performance/Cost Trade-Off

# ***Future Fire Control System Approach***

- Integrated Approach
- Use Of Standards
- Modular



# ***Future Fire Control Software Approach***

- DOD-STD-2167
  - Top-Down Design, Bottom-Up Testing
  - Module Size Limit (200 Lines of Code)
- ADA
  - Structured Programming
  - 10% Assembly Code Limit
  - Built-In Program Design Language
- Module Complexity Index
  - Limit Of "10"
- Test Hooks For Greater Debug Capability
- Goal Is To:
  - Achieve Structured, Less Complex Software
  - Increase Maintainability And Reliability

# ASM Fire Control Technology Focus

## VEHICLE INTEGRATION



### ACQUISITION/SIGHTING

- OPTICS
- CCD TV (Change Coupled Device TV Camera)
- FPA (Focal Plan Array)
- MMW/CPS (Radar/Combat Protection Sys)
- ACOUSTICS
- LRF (Laser Range Finder)

### SENSOR

- CMRS (Continuous Muzzle Reference Sys)
- MET
- POS/NAV (IMU)
- AUTO BORESIGHT/ZERO
- DYNAMIC CANT
- WIND
- ACTUATOR
- AMMO DATA LINK

### INTERFACE

- DIGITAL ADAPTIVE STAB
- ELECTRIC GUN/TURRET DRIVE
- SAVA COMPATIBLE  
High Speed Data Bus, Video, Utility,  
Power, System Backplane Bus
- COMMUNICATION
- DISPLAYS

### TURRET DRIVE/STABILIZATION

### PROCESSING FUNCTIONS

- IMAGE ENHANCEMENT
- AUTOMATED TARGET DETECTION
- AIDED TARGET RECOGNITION (ATR)
- AUTOMATED TARGET TRACKING
- MANEUVERING TARGET PREDICTOR
- BALLISTICS

- PRECISION GUN AIMING
- EMBEDDED TRAINING
- EMBEDDED DIAGNOSTICS
- DECISION AIDS

### SYSTEM ANALYSIS

- QUANTIFY COMPONENT PERFORMANCE  
TO REQUIREMENTS
- SENSITIVITY ANALYSIS
- FORCE ON FORCE ANALYSIS

# ASM CATTB

## Fire Control Plan

	FY90	FY91	FY92	FY93	FY94
<b>(TACOM) - CATTB</b> <ul style="list-style-type: none"> <li>● Col Dept/Component Dev</li> <li>● Sys Integ Lab/Demo</li> </ul>					
<b>(ARDEC) - CATTB</b> <ul style="list-style-type: none"> <li>● Extended Range Gunnery F.C. Program</li> <li>● Auto Detect/Track</li> <li>● Digital Adaptive Stabilization</li> <li>● Maneuvering Target Prediction</li> <li>● Auto Boresight</li> <li>● Electric Gun/Turret Drive</li> <li>● Embedded Training</li> </ul>					
<b>SENSOR PACKAGES</b> <ul style="list-style-type: none"> <li>● NVL, PM Stingray - CATTB</li> <li>● FLIR Acquisition Sight</li> <li>● Fire Control Radar</li> <li>● C/Ps (Combat Protection System</li> </ul>					
<b>ARDEC Fire Control Funding</b>	<b>\$5.0M</b>	<b>\$14.0M</b>	<b>\$3.0M</b>	<b>\$5.0M</b>	

# *Fire Control System*

## *Considerations*

INTEGRATED  
C<sup>3</sup>I INTERFACE

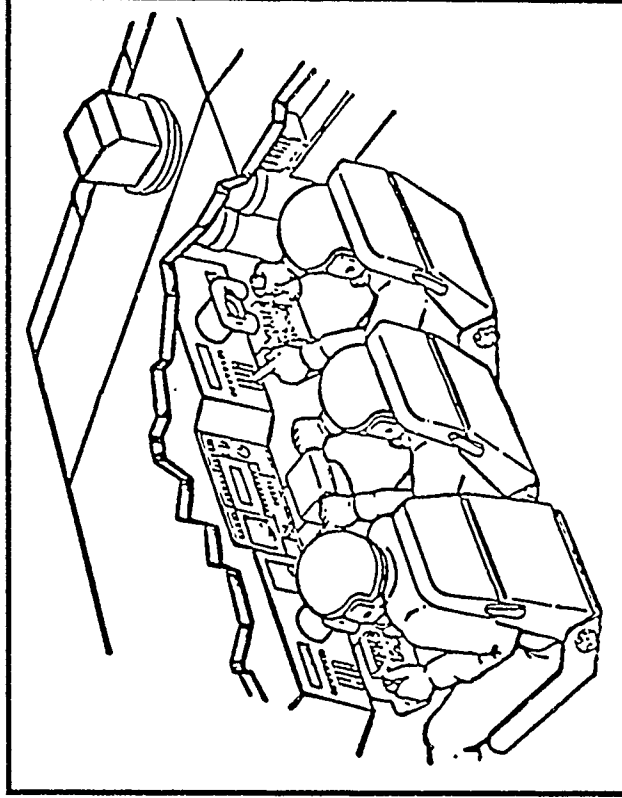
SAVA

MULT-  
SPECTRUM  
SENSORS

AUTOLOADER  
AND  
WEAPON CONTROL

EXTENSIVE  
DATA/SIGNAL  
PROCESSING

GUN/TURRET  
DRIVE  
SYSTEMS



VEHICLE  
STATE  
SENSORS

ENHANCED  
WEAPON/SIGHT  
STABILIZATION

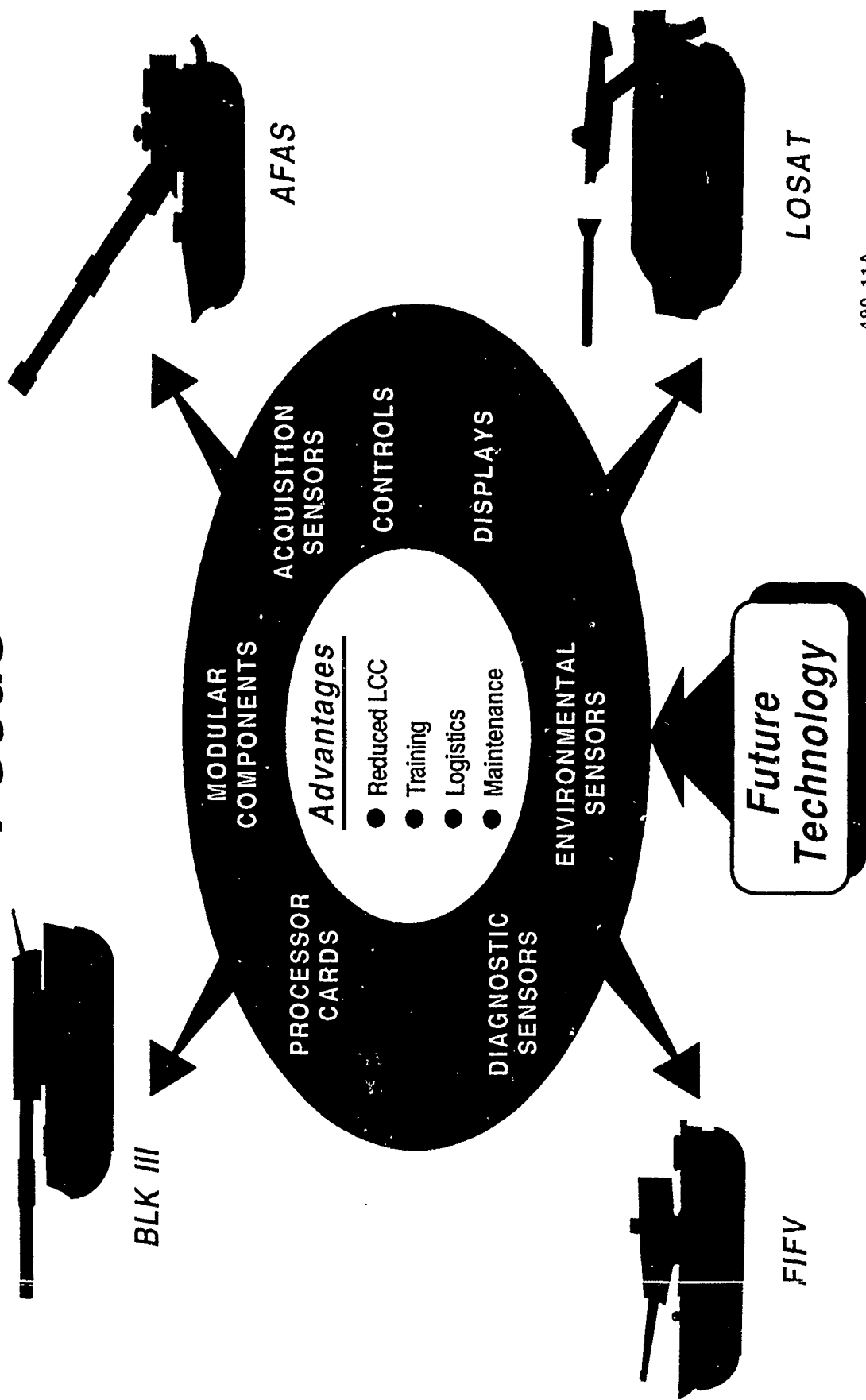
MULTI-FUNCTIONAL  
CONTROLS AND  
DISPLAYS



ASM PROGRAM FOCUS

# ASM Fire Control System

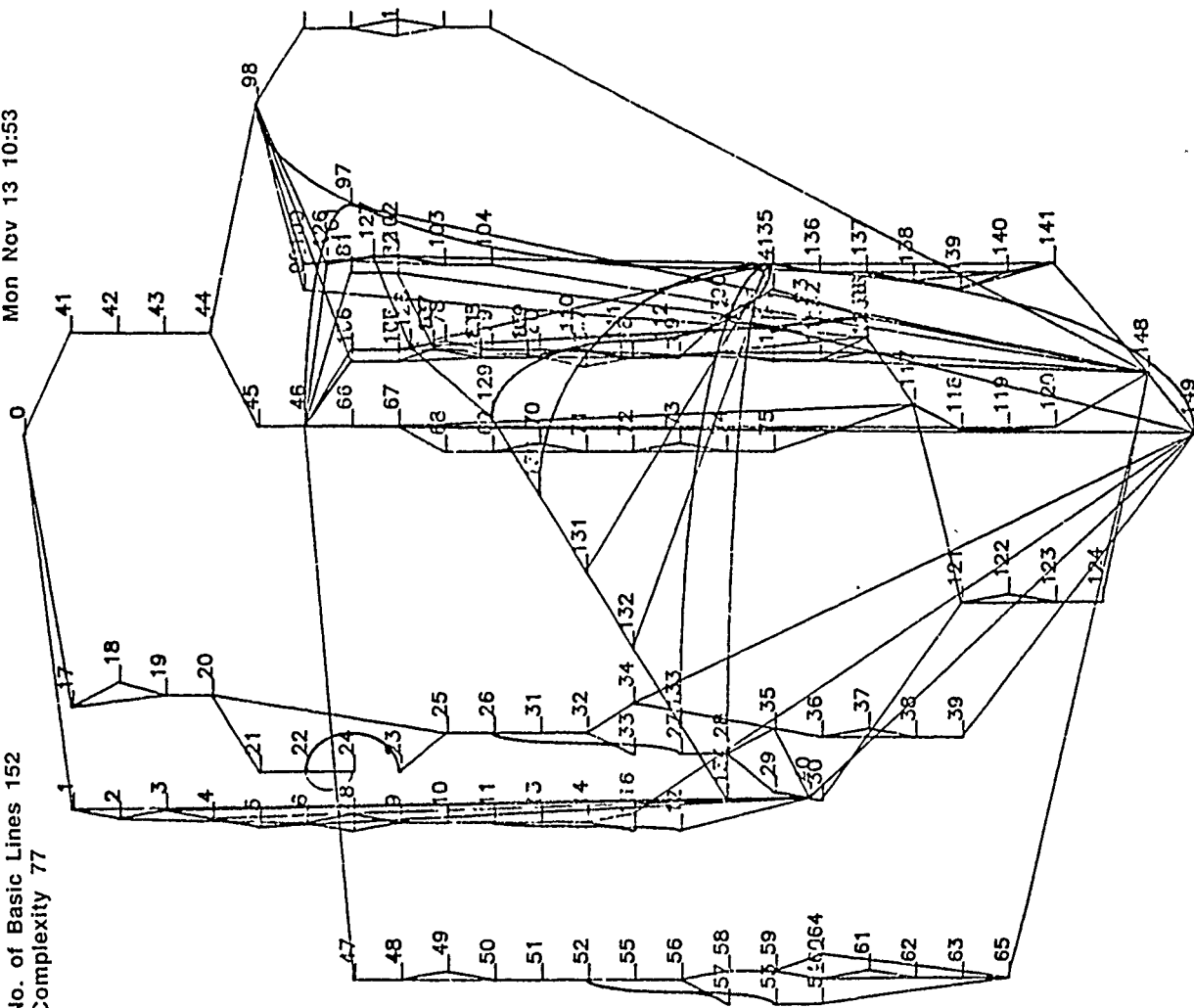
## Focus



bucs33.b  
 SUB — WPNREL, GOSUB — 1025, GOSUB — 1  
 No. of Basic Lines 152  
 Complexity 77

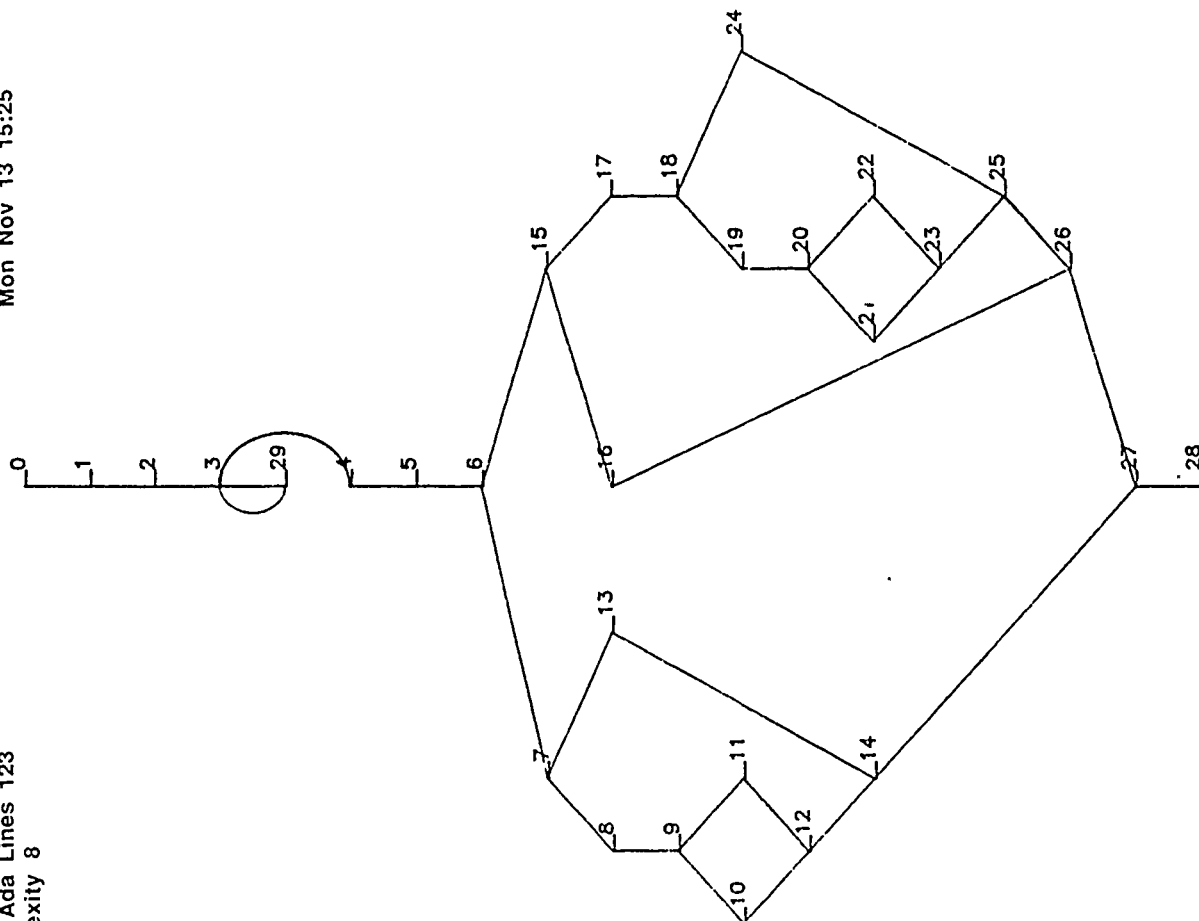
Upward flows  
 Loop exits  
 Plain Edges

Mon Nov 13 10:53



Upward flows  
Loop exits  
Plain Edges  
Mon Nov 13 15:25

bcwc76.ada  
INITIALIZE  
No. of Ada Lines 123  
Complexity 8





# ***Challenge To Industry***

- Commonality Of Fire Control System Components For ASM Variants
- Extend Detection And Engagement Range
  - Sensor Capability
  - Crew Function
  - Man/Machine Interfaces
- Develop Innovative Techniques To Improve Armament System Accuracy
  - Gun Dynamics Compensation
  - Automated Gunner Function
  - Boresight, Zero, Alignment Techniques
  - Algorithm Development
- Embedded Tactical Training Concept

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# *Summary*

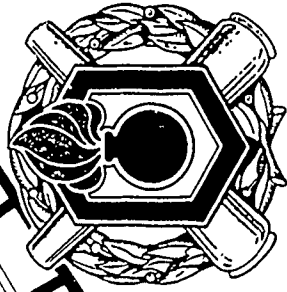
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- Combat Vehicle Fire Control Will Evolve From Hardware Intensive System To Software Intensive System
- Heavy Emphasis On Hit Probability And Target Acquisition Improvements
- New Integration Approach To Ensure System Performance Flexibility And Affordability
- Industry Participation/Commitment
  - Sensor Fusion
  - Signal Processing
  - Compensation Of Gun Dynamic
  - Electronic Integration

**Advanced  
Planning for  
Briefing for  
Industry**

**DECADE OF  
CHANGE  
90'S**



**Armament Challenges for  
the 1990's . . .**

# ***Extended Range Munitions***

PRESENTED BY

**FRANK BRODY**

**FIRE SUPPORT ARMAMENTS CENTER  
724-3816**

# ***Briefing Outline***

- What Are Extended Range Artillery Munitions?
- Program Overview
- Program Focus
- Status
- Plans
- Challenges To Industry
- Summary

# Program Overview

## Objectives

- To Provide The Capability To Deliver Artillery Fires At Significantly Greater Ranges To Defeat Materiel Targets

## Technology Barriers

- Use Of Composite Materials For Cannon Launched Munitions
- Higher Energy, Low Vulnerability Propellants

## Needed Technologies

- Breakthrough In Area Of In-Flight Propulsion
- Improved Ignition Delay/Igniter Systems
- Improved Obturators/Rotating Bands
- Alternate Payload Expulsion Techniques

## Payoffs

- Capability To Defeat Deeper Targets
- Greater Ability To Mass Artillery Fires
- Increased Survivability

# **Program Focus**

- Develop Advanced In-Flight Propulsion Techniques
- Utilize Increased Muzzle Velocity
- Incorporate Use Of High Strength/Weight Materials
- Derive New Cargo Expulsion Techniques
- Develop New Cost Effective Anti-Materiel, Anti-Personnel Payloads

# **Status**

## **Design Status**

- Completed Initial Concept Studies
- Identified Concepts For In-Flight Or Launch Propulsion
- Identifying Potential Payloads
- Evaluating Base Burn/Rocket Motor Assist Combination

## **Potential Applications**

- Delivery Of Improved Conventional Munitions
- Sense And Destroy Armor Submunitions
- Anti-Materiel Anti-Armor Munitions

# **Plans**

- Translate Basic Design Concepts Into Detailed Designs
- Conduct Detailed Interior Ballistic, Exterior Ballistic, And Stress Analyses
- Fabricate Prototype Hardware
- Conduct Tests To Verify Predicted Performance



# ***Means For Increasing Range***

- Increase Muzzle Velocity
- Reduce Drag
- Add Post-Launch Propulsion

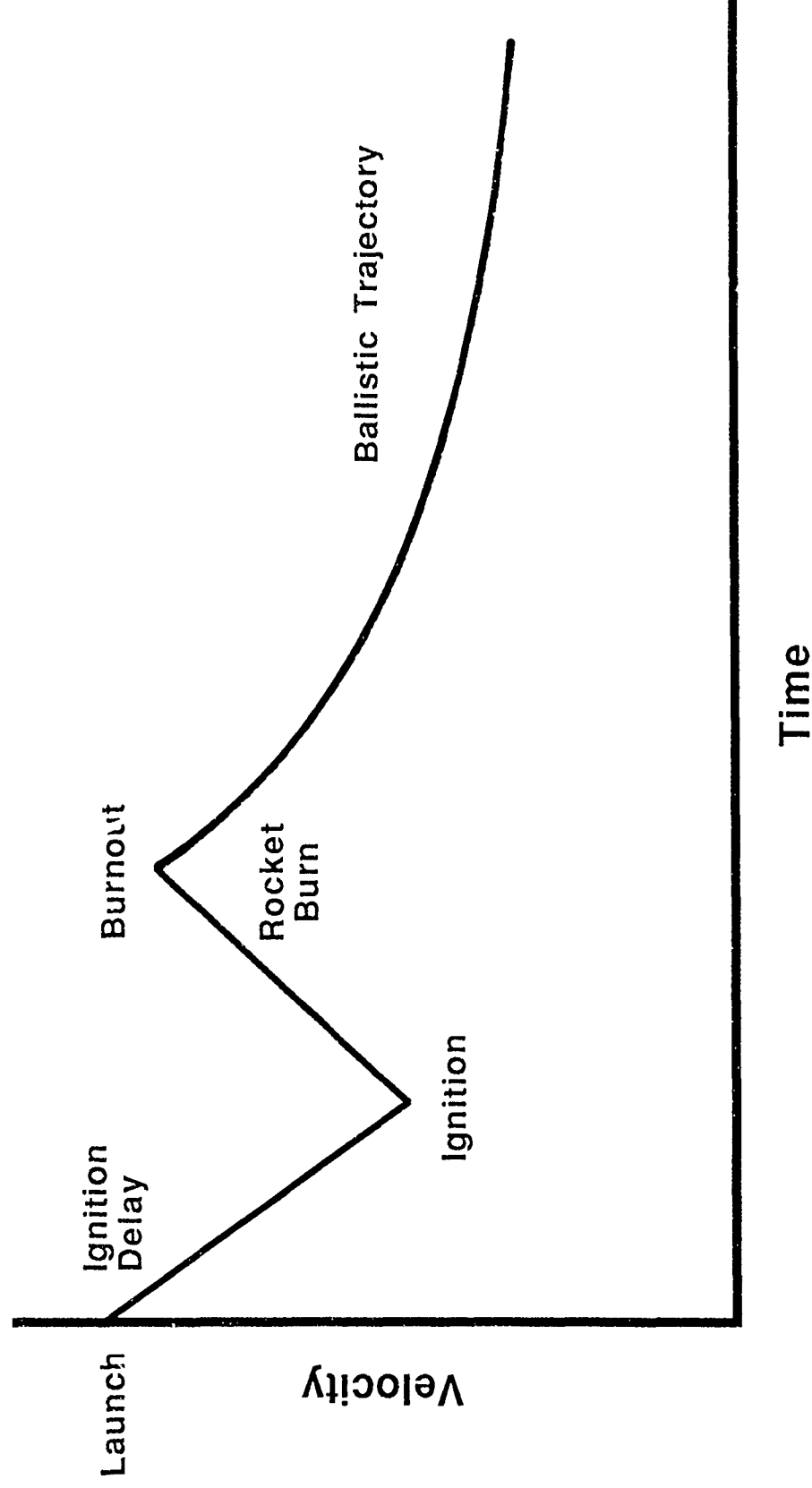
# ***What Are Extended Range Projectiles*** ==

## ***Projectiles That Utilize Post Cannon Launch Propulsion Systems To***

- Engage And Defeat Deeper Targets
- Increased Survivability
- Permit More Effective Lateral Mass Fires
- Minimize Weapon Displacement
- Exploit Capabilities Of Future Artillery Systems

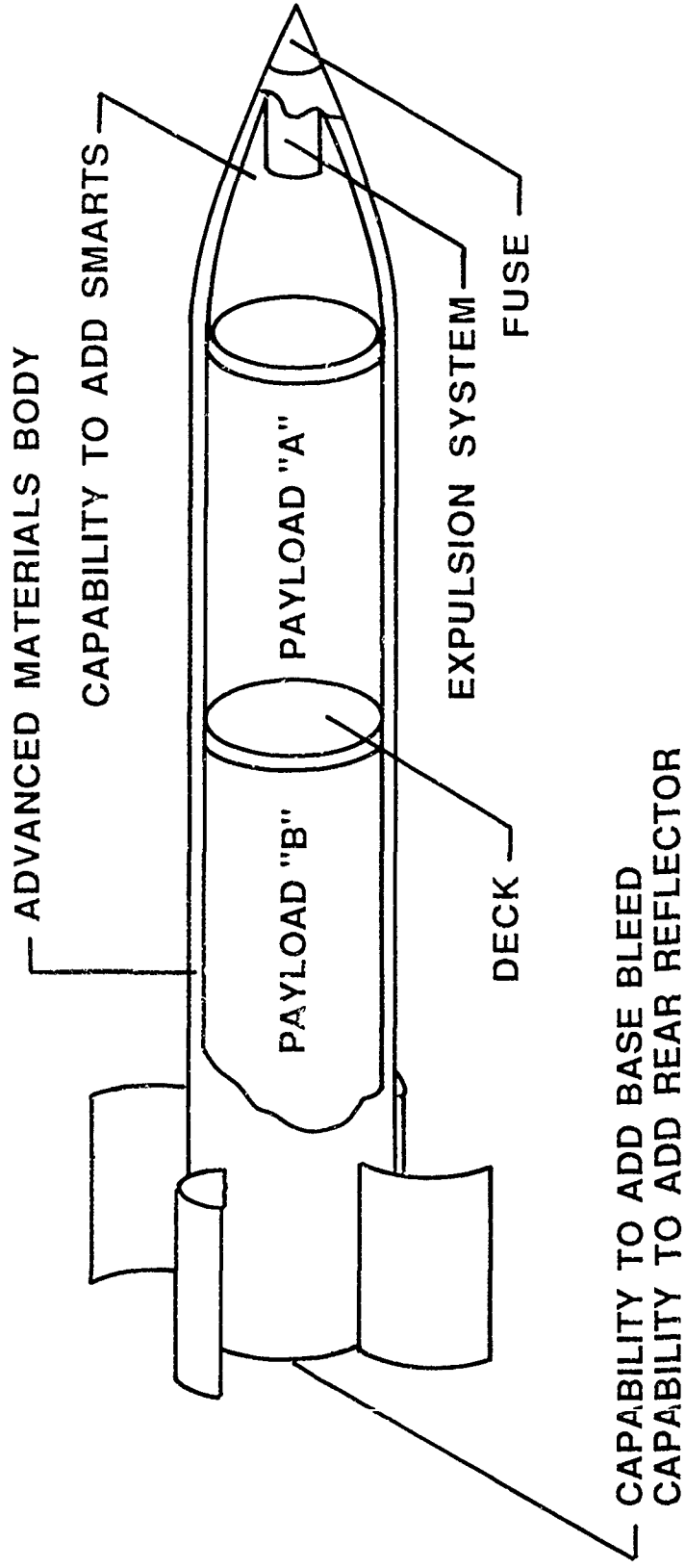
# ***Rocket Assist Projectile***

## ***Velocity Profile***



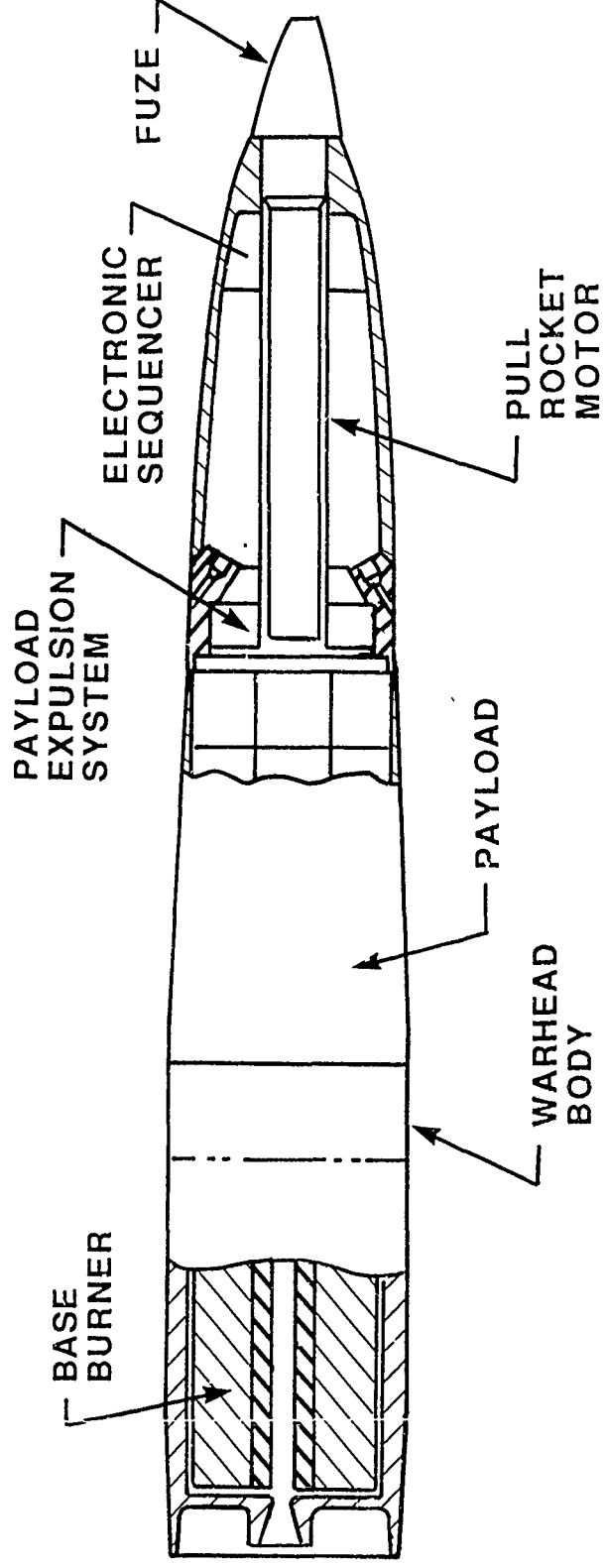
# *Potential Applications for Extended Range Carrier*

## HI-CAP



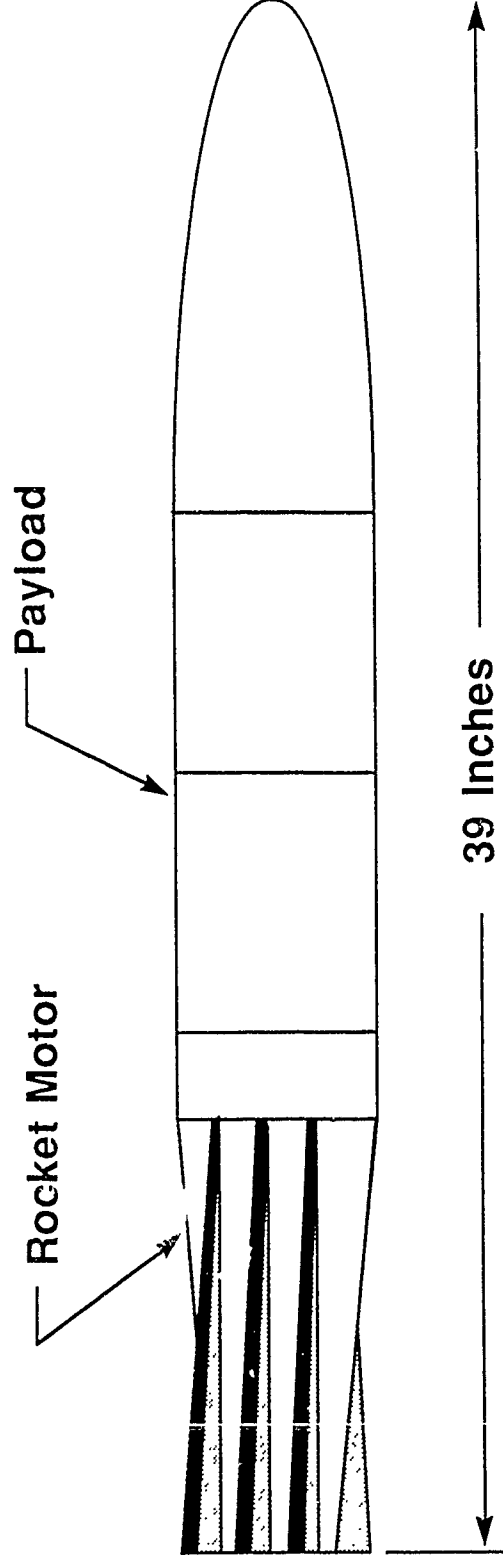
# *Potential Applications for Extended Range Carrier*

## Pull Motor Design



# ***Potential Applications for Extended Range Carrier***

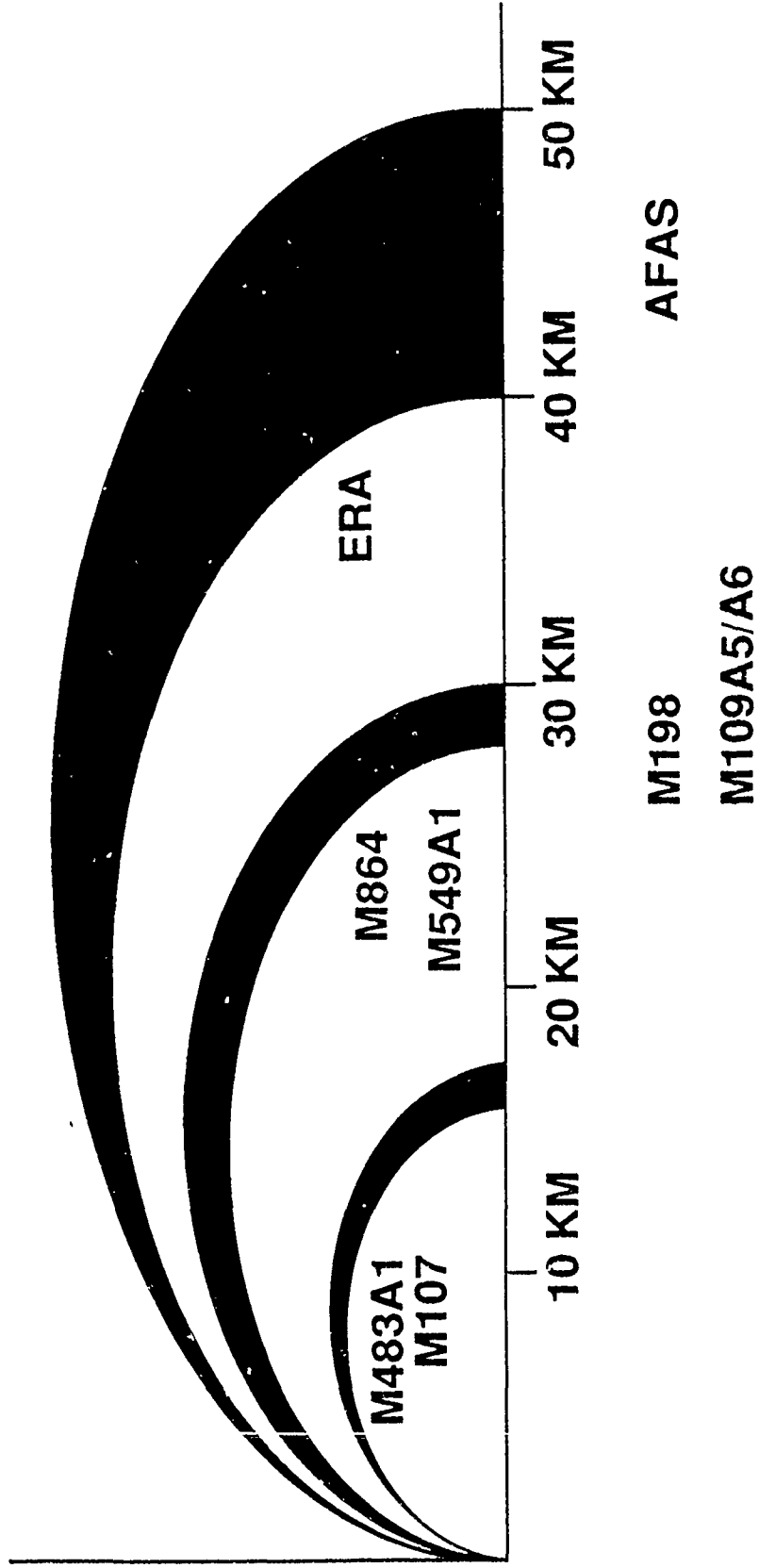
**Spin-Stabilized Finned Projectile**



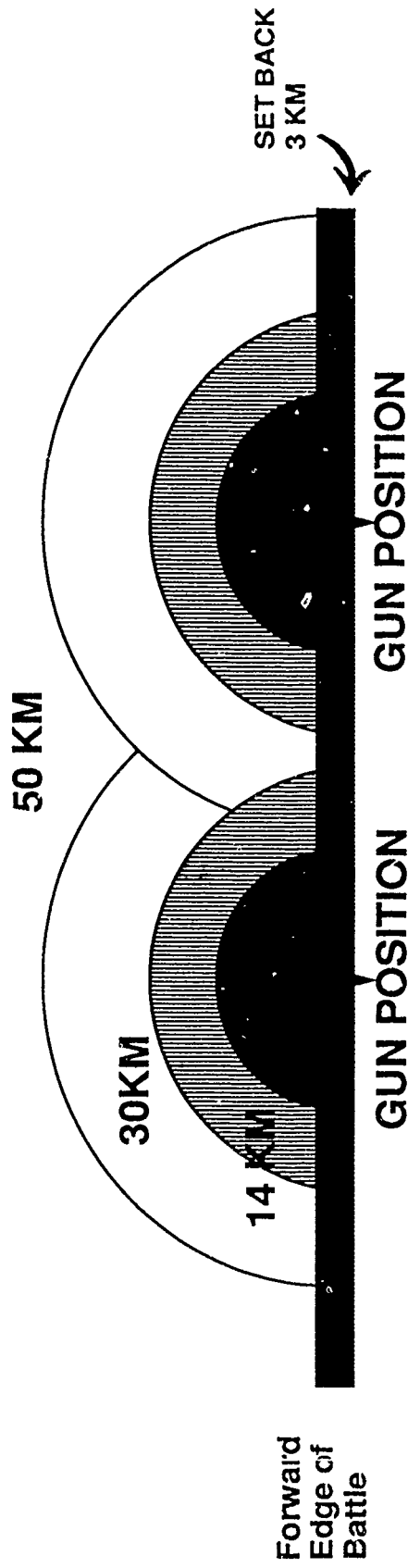
**Max Range: 45 KM**

# **Current And Future Ranges**

## **155mm Artillery Systems**



# AREA COVERAGE



- INCREASED AREA COVERAGE ~ 350%
- INCREASED SURVIVABILITY



# Plans Extended Range Munitions

FY	90	91	92	93	94	95
<u>Tech Base</u>						
Concept Formulation						
Detailed Design						
Aeroballistic Analyses						
Prototype Evaluation						
<u>Development</u>						
FSED						
\$ Millions	.5	.5	1.0	2.0	2.0	3.5

# **Summary Of Requirements**

## **Industrial Participation Needed In The Following Areas**

- Develop Higher Strength/Weight Materials
- Develop Improved, Highly Reliable, Rocket Motor Igniter And Payload Expulsion Methods
- Provide Improved Cost Effective Fabrication Techniques
- Develop Payloads Having Enhanced Effectiveness

# ***Challenges to Industry***

## ***The Technical Expertise Of Industry Is Required For The Development Of***

- Higher Energy, Low Vulnerability Propellants
- Low Cost, High Reliability Rocket Motor Ignition Systems
- Improved Payload Expulsion Techniques
- High Strength To Weight Materials
- Improved Fabrication Techniques For Components And Munitions
- Multifunctional Devices For Rocket Motor Ignition And Payload Expulsion

# ***Project Summary***

- Formulated Extended Range Projectile Design Concepts
- Identified Promising Applicable Post Launch Propulsion Systems
- Determined Critical Weapon/Ammunition Interfaces
- Investigating New Payload Expulsion Techniques

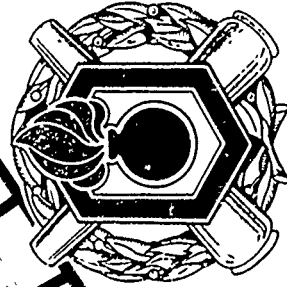
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**Advanced  
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**DECADE OF  
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***Armament Challenges for  
the 1990's . . .***

# ***Command and Control (C2) of Mines***

PRESENTED BY

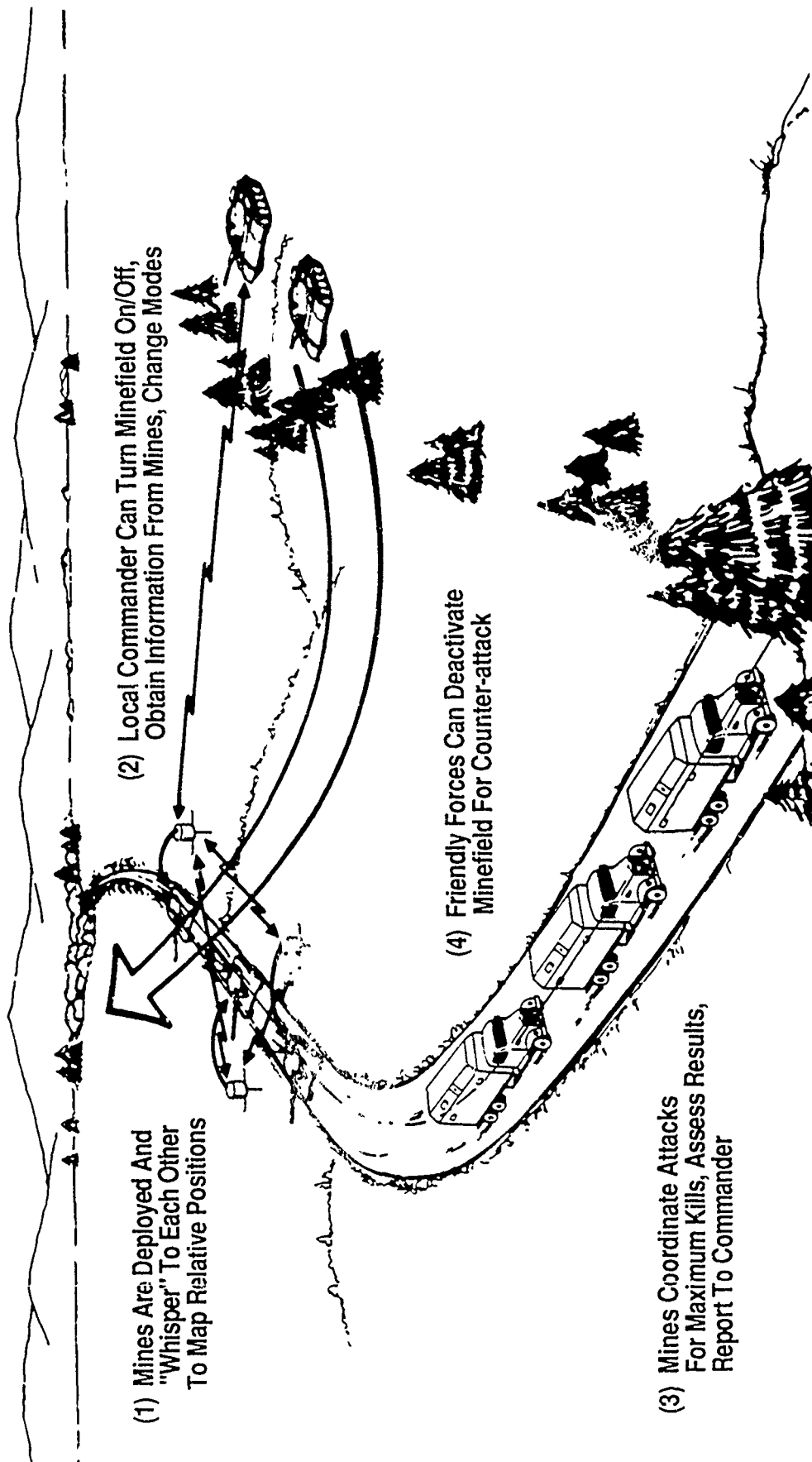
**WAYNE AHLERS**

**FIRE SUPPORT ARMAMENTS CENTER  
724-6118**

# **Outline**

- What Is C2 Of Mines
- Objective
- Program Focus
- Army/DARPA Program Status
- Near Term Plans
- Future Industry Challenges/Opportunities
- Summary

# What Is C2 Mines





# ***Objective***

## ***Develop And Field A Capability For***

- Remote Mode Change Of Mines
- Report Status/Activity
- Autonomous Intra-field Communication
- Maintaining Covertness And Countermeasure Resistance Of Minefields

# Program Overview



## TECHNOLOGY BARRIERS

- Unit Cost For Communication System
- Power Burden
- Small Size

## NEEDED TECHNOLOGIES

- Rugged, Small Communication Electronics
- Improved Power Sources
- Innovative Concepts For High Reliability Internal On/Off Control Of Mine Events

## PAYOFFS

- Maneuver Freedom Of Friendly Forces
- Status/Threat Reporting
- Improved Performance

# **==Army/DARPA Program Status==**

- Recommended By 1986 Defense Science Board
- Broad Agency Announcement Issued In FY87
- Concept Definition Phase Awarded In FY88
- Concept Exploration Phase Awarded In FY89
  - Breadboard Demos At Sandia National Lab FY90/FY91
  - \$12M Contract Dollars Invested To Date

- 
- 
- Discussion Of Future Plans Needs Brief Description
  - Family Of Scatterable Mines - FASCAM
  - The Wide Area Mine - WAM
  - The Intelligent Minefield Concept - IMF

490C4-PH

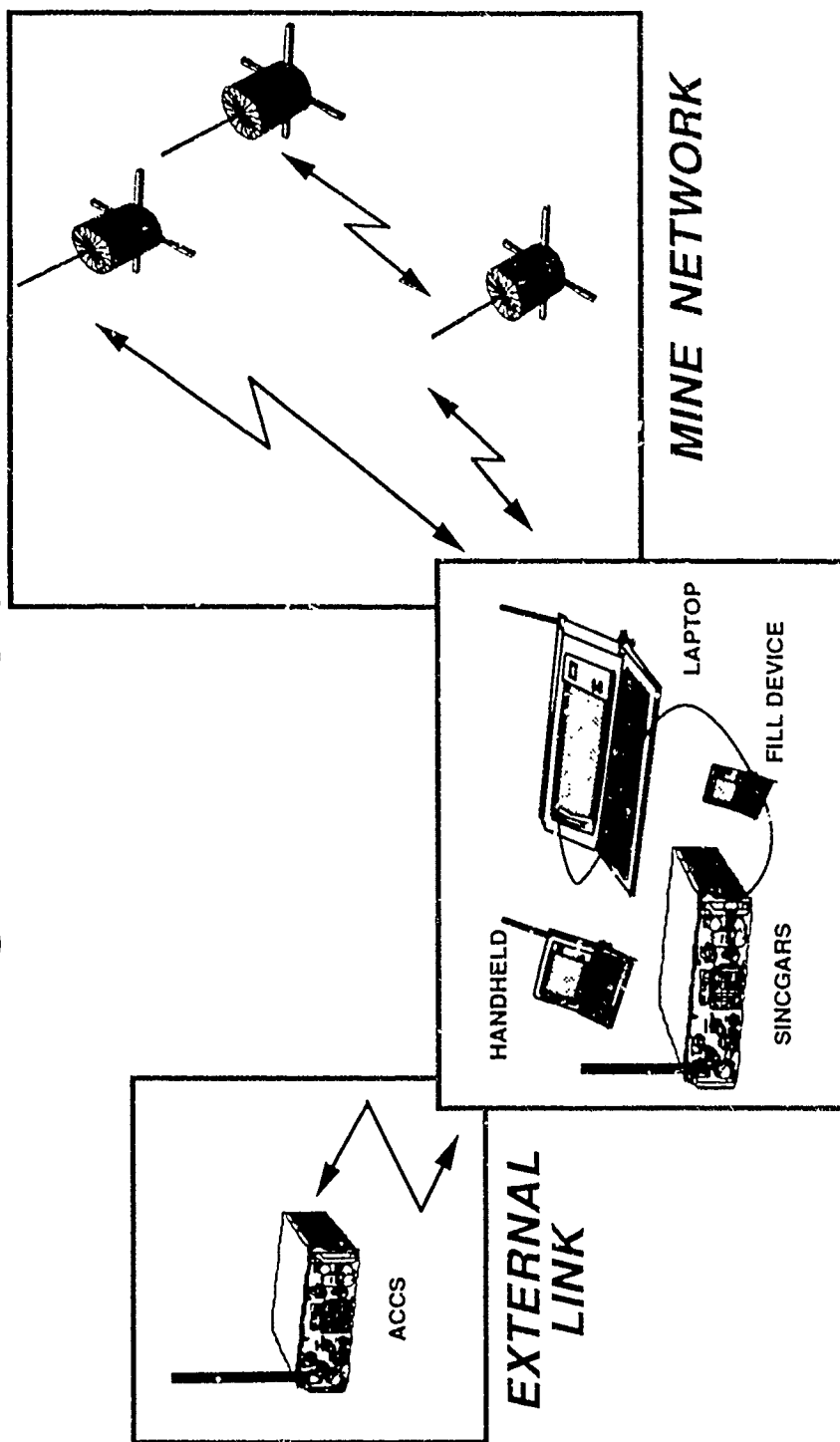
# Plans - Command Control MINE

	FY90	FY91	FY92	FY93	FY94	FY95	FY96
Hand Emplaced WAM Development Command Control For WAM	FSD						PROD
	C2 POP						VOLCANO WAM DEEP ATTACK WAM
	*						PROD IMPROVEMENT PROGRAM PROD
Intelligent Minefield	6.2	6.2		6.3A			
	MODELING	COMPONENT		DEV	DEMOS	FSD	
C2 Application \$ And IMF \$	*	*					
	\$5M	\$5M	\$9M	\$9M	\$5M		

\* NEW STARTS

490C7-PH

# **Focus - Command/Control Of Mines**

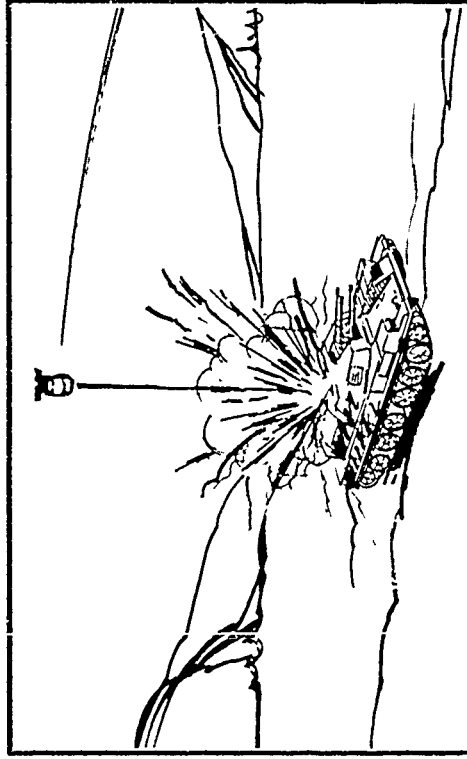


## **CONTROL STATION**

**Develop And Test Hardware Elements, Their Interfaces  
And Associated Imbedded Software**

490C8-PH

# Intelligent Mine Field



## ADVANTAGES

- Coordinate Use Of Smart Mines, Scatt Mines, Conv Mines, Sensors & Robotic Sys
- Enhance Effectiveness By Selective Targeting
  - Ambush, Divert, Delay
  - Reinforce Breach Defense
- Reduce Manpower In The Battle Area & Logistics Tail

## DESCRIPTION

- Mines/Sensors Linked By C2
- Mapping Of Mines/Targets
- AI Selection Of Tactics
- Robotic Elements To
  - Deploy, Replace, Recover And As Mobile WAM Platform

## STATUS/SCHEDULE

- SRIR To Develop Simulation/Modeling/ AI Software
  - Phase I Complete FY89
  - Phase II Award 4QTR FY89
  - Delivery Of Software 4QTR FY90
- Will Be Used To Define IMF & Future Demos FY91

# Intelligent Mine Field



- USER CHALLENGES
- Min Logistics
  - Simple
  - Mult Application

## TECHNOLOGY BARRIERS

- Unit Cost For Communication System
- Power Burden
- Small Size

## NEEDED TECHNOLOGIES

- Rugged, Small Communication Electronics
- Improved Power Sources
- Innovative Concepts For High Reliability Internal On/Off Control Of Mine Events

## PAYOFFS

- Maneuver Freedom Of Friendly Forces
- Status/Threat Reporting
- Improved Performance

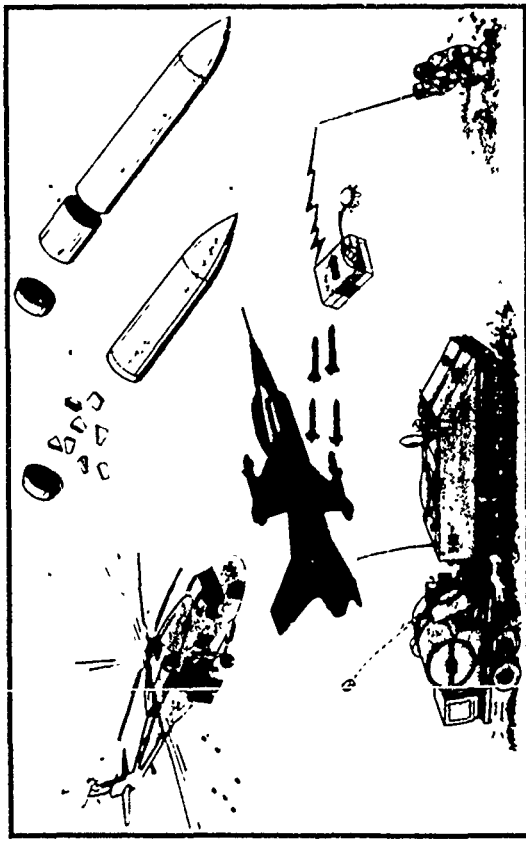


# FASCAM

ADAM, RAAM, GEMSS, GATOR, VOLCANO, MOPMS, PDM

## USER PAYOFF

- Responsive, Flexible Area And Point Mining Capability
- Artillery, Air Ground And Manual Emplacement Options
- Extended Shelf Life
- Improved Logistics



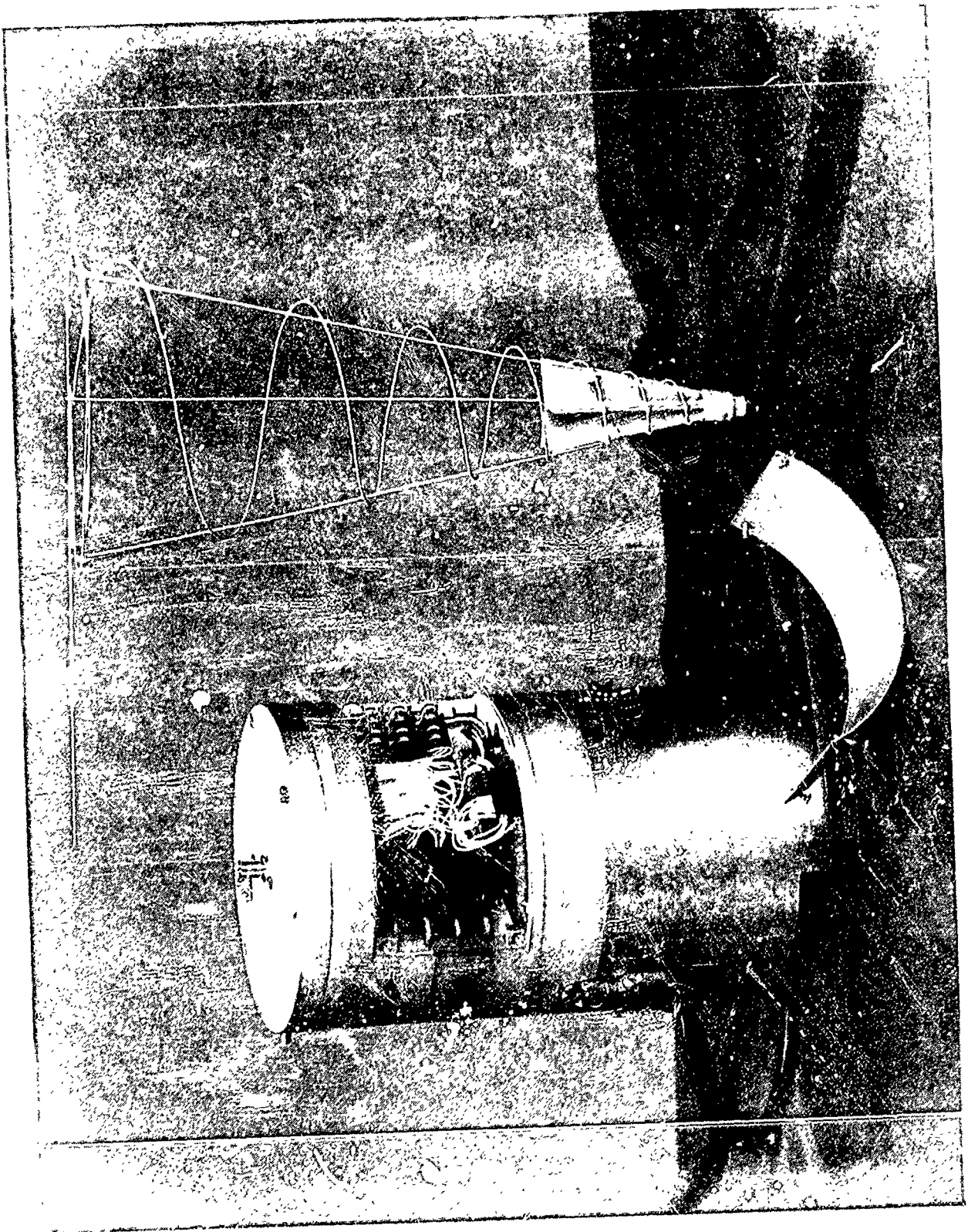
## DESCRIPTION

- 4 LB/5 In. Dia Common Size AT/AP
- Most Components Common
- Full Width At Sensor
- Multiple Tripline Wide Area AP Sensor
- Efficient Warheads
- Scatterable, Dual Sided Function
- Self Destruct Timers
- Reserve Batteries

## PLANS

### System Fue (Completed/Scheduled)

- ADAM/RAAM - FY82
- GATOR - FY86
- GEMSS - FY86
- VOLCANO - FY91 GND/FY94 AIR
- MOPMS - FY92
- PDM - FY90



# **Challenges To Industry**

## **Deep Attack Follow On WAM Applications**

- More Rugged/Reliable Command Control Systems For Delivery Mode Of Mines Relative To Hand Emplaced Version

## **Intelligent Minefield Concept**

- Exploit Data Links - Coordinate Minefield Elements
- Lower Cost Links To FASCAM/Mixed Minefields
- Dedicated Sensor Platforms
- Artificial Intelligence Based Local Controllers

## **Cooperative/Long Range Targeting Possible With C2 Allows New System Concepts**

- Very Wide Area Mine
- Mobile Mines

# Summary

## Project Summary

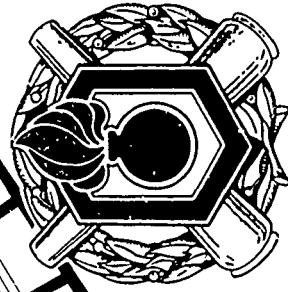
- Developing Two Way Data Link To Minefields
- Demo Program Near Conclusion
- Application To WAM Is Coming
- Will Apply In Future Mine Warfare Concepts

## Industry Participation Needed In Following Areas

- Smaller, Rugged Communication Modules
- Improved Power Sources
- Innovative Internal On/Off Control Devices
- Low Cost Systems For High Density Minefield Application

**Advanced  
Planning  
Briefing for  
Industry**

**DECADE OF  
CHANGE  
90'S**



**Armament Challenges for  
the 1990's . . .**

# **Warhead Developments**

PRESENTED BY

**JAMES C. PEARSON**

**ARMAMENT ENGINEERING DIRECTORATE  
724-2516**

# ***Briefing Outline***

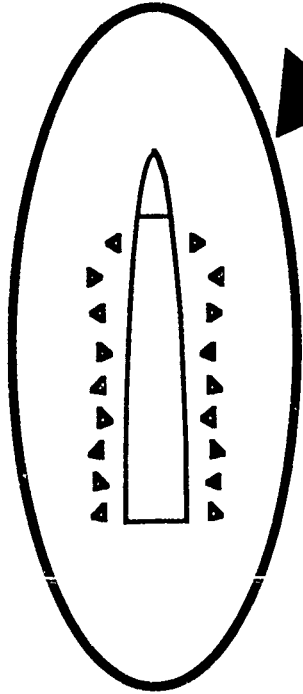
- Warhead Definition
- Overview
- Program Focus
- Status
- Plans (Funding)
- Challenge To Industry
- Summary

490G5PH

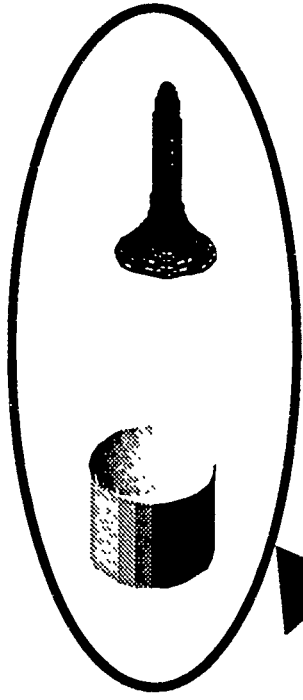
# What Are Warheads?

Anti-Materiel/Personnel

Anti-Armor

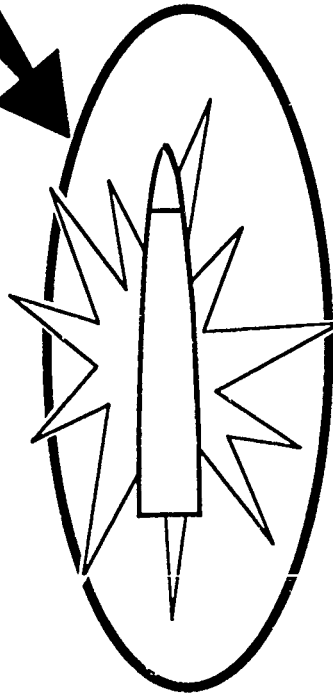


Fragmentation

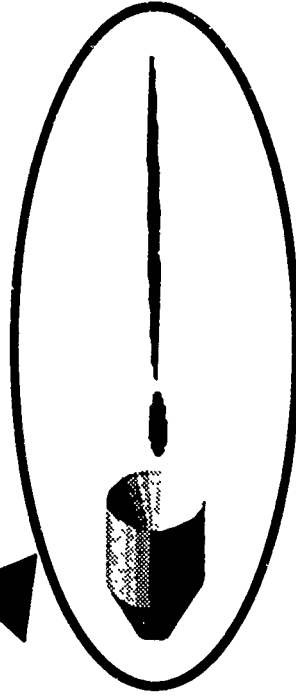


Explosively Formed Penetrator

Conventional Warhead Development



Blast



Shaped Charge

# Shaped Charge Program Overview

## Objective

- Develop Advanced Tandem Warheads To Defeat Future Appliques

## Technology Barriers

- Achieving High Performance From Compact, Lightweight Warheads
- Blast Leakage And Interactions In Compact Warhead Configurations Can Pose Serious Problems To Proper Rear Charge Functioning

## Needed Technologies

- More Powerful Explosive
- Liner Materials Which Produce More Efficient Jets
- Jet-Blast Interaction Database

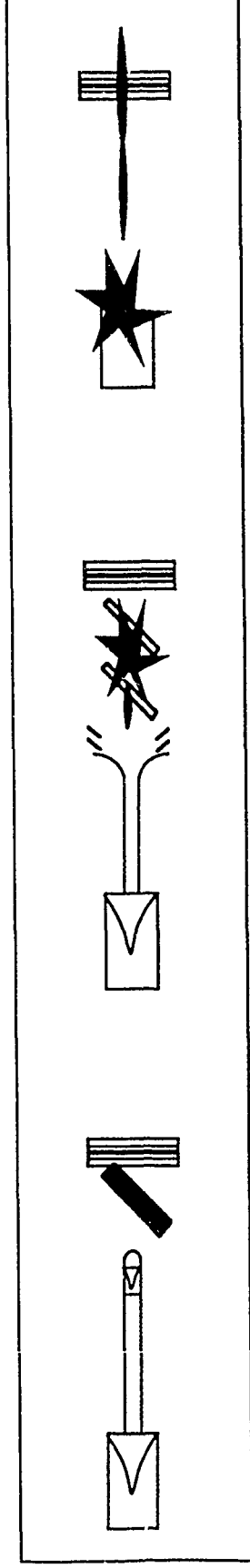
## Payoffs

- [Robust] Warhead Solutions Which Can Be Defeated Only By Very Heavy Armors



# **Program Status Shaped Charge**

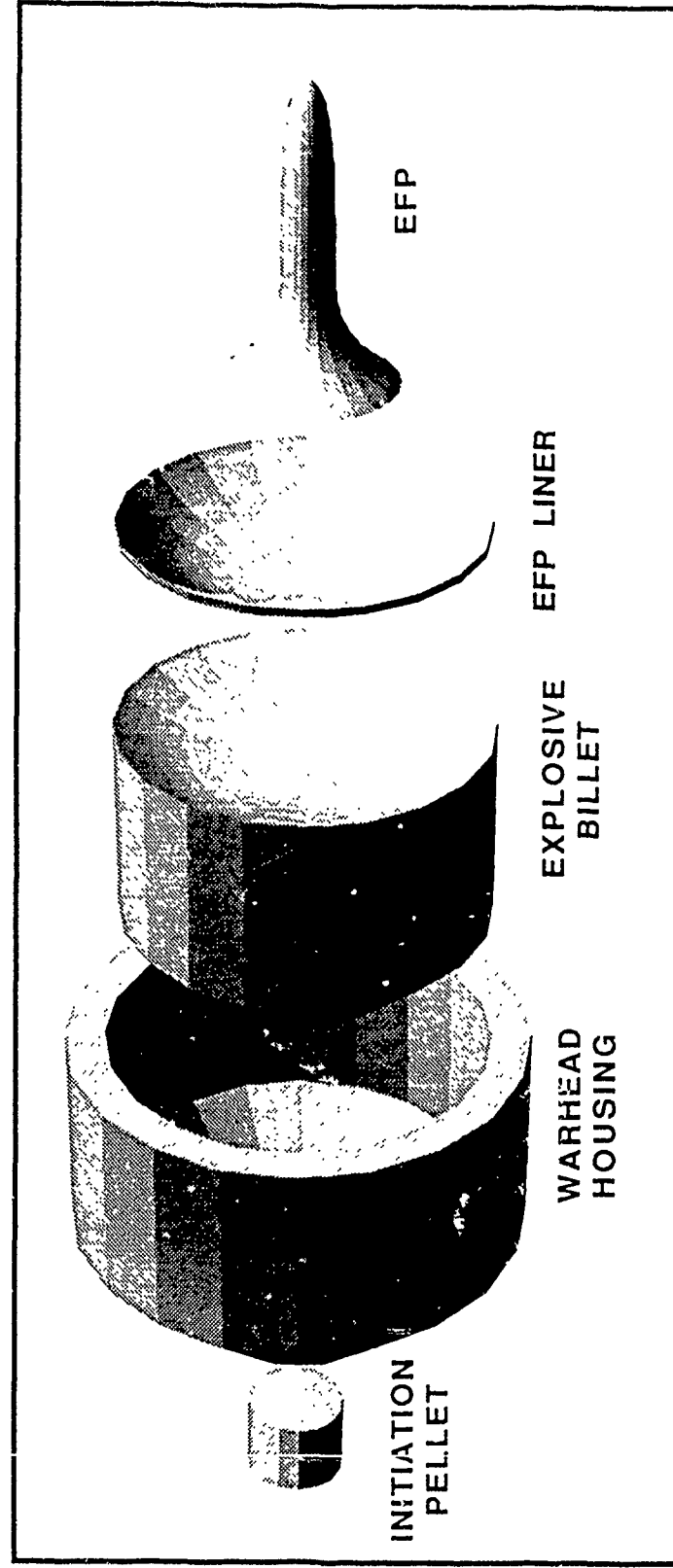
- ***Tandem Shaped Charge Warheads Have Defeated Reactive Armor Protected Tank Range Targets***



- ***Technology Development Ongoing For Tandem Components To Defeat More Difficult Targets***

490G8PH

# ***Explosively Formed Penetrator (EFP) Warhead***



490G11PH

# EFP Program Overview

## Objective

- Develop Advanced Warheads For Conventional/Smart Munition Systems
  - Efficient
  - More Lethal
  - Less Vulnerable
  - Adaptable

## Technology Barriers

- Dependence Of EFP Formation On Liner Processing History
- Liner Manufacturing Process
  - Consistent
  - High Quality
  - Low Cost

## Needed Technologies

- New High Density Liner Materials
- Tantalum Metallurgy
- More Powerful Explosive
- Selectable Warheads

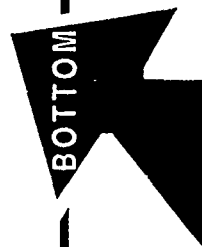
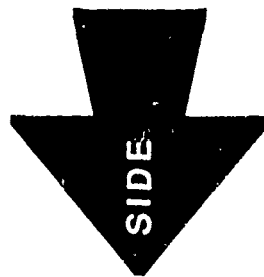
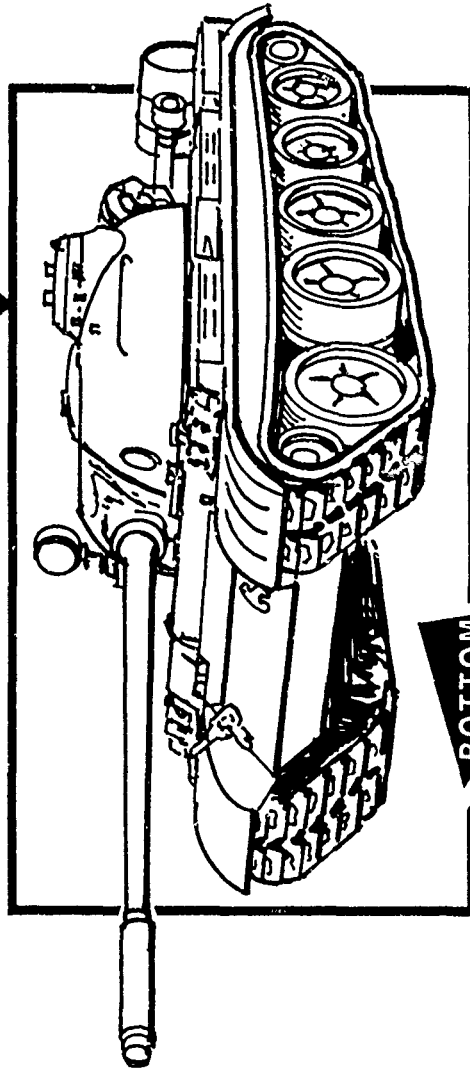
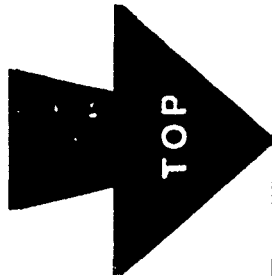
## Payoffs

- Maintain Target Overmatch
- Enhance System Effectiveness
  - Light Targets
  - Longer Standoff Capability
  - Improved Accuracy

# ***Program Focus- Defeat Armor Targets***

## **TARGET DEFEAT**

EF&P Systems To Defeat Armor



490G10PH

# ***== EFP Technology Focus ==***

- Explosively Formed Penetrator (EFP) Warheads For Top Attack
- Efficient (Lightweight) Warheads
- Longer Length To Diameter EFPs
- More Lethal Warheads
- Selectable Warhead

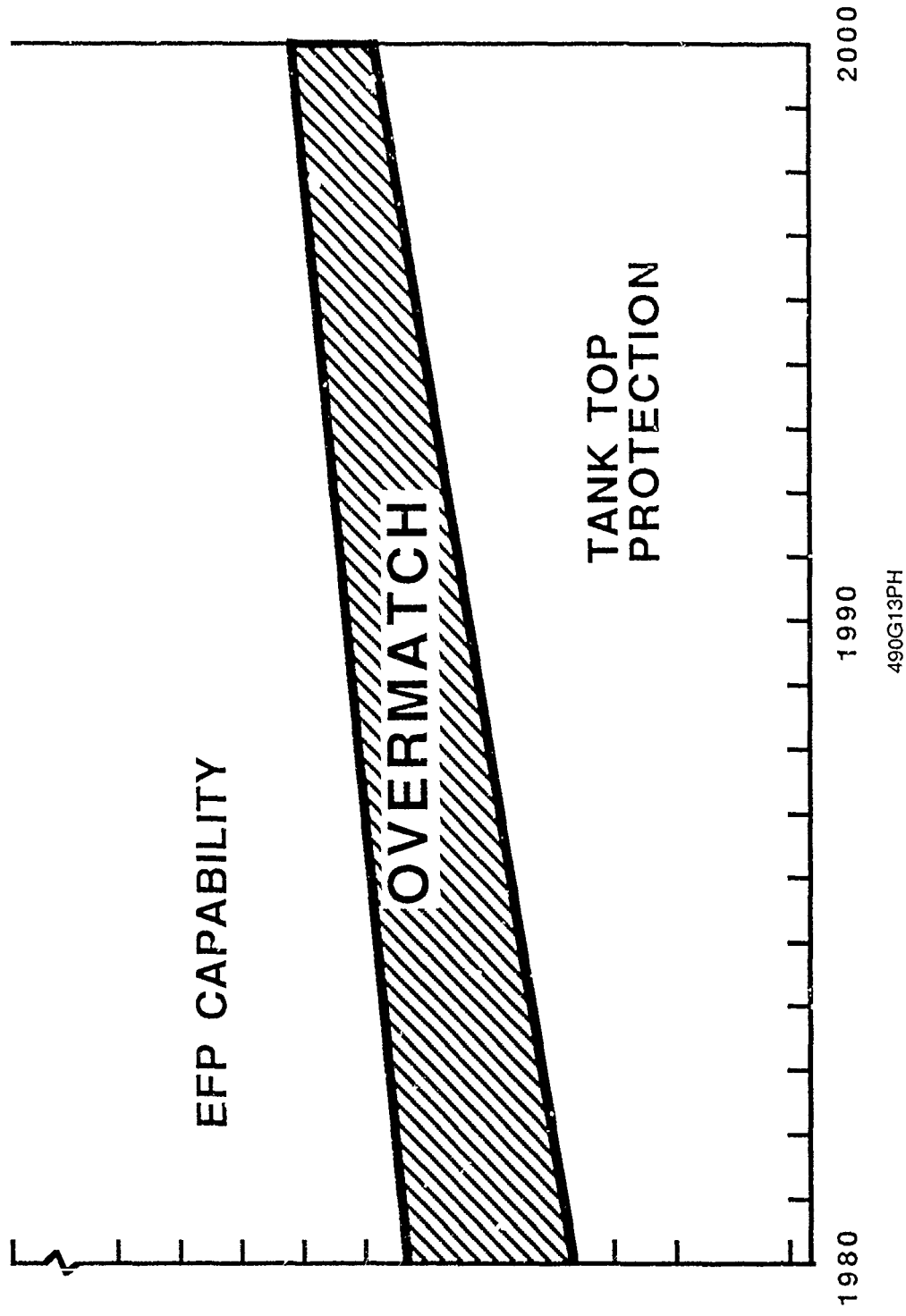
490G3PH

# **== EFP Program Status ==**

- EFPs Defeat Current Tanks (Turret And Engine)
- Technology Development Ongoing To Defeat More Difficult Targets
- EFP Technology Effectively Used As Lethal Mechanism For
  - SADARM
  - SFW Skeet (Air Force)
  - TOW 2B
  - WAM

490G4PH

# ***Growth Potential Of EFP Warheads***



# **Warhead Development Plan**

FY

	91	92	93	94	95
More Powerful Explosives (6.1/6.2)					
Target Defeat (6.2)					
Advanced EFP Technology Demonstrations (6.3A)					
Tech Base Total Funding	2.6M	6.2M	7.5M	7.7M	8.9M

490G12PH



# ***Challenge To Industry***

- New Advanced Warhead Concepts
- New High Density Liner Materials
- Improve Manufacturing Process For Consistent, Low Cost, High Quality Liners
- Improve Material/Fracture Models For Computer Analyses Of EFP Formation/Target Interaction

490G1PH

# **Warhead Development**

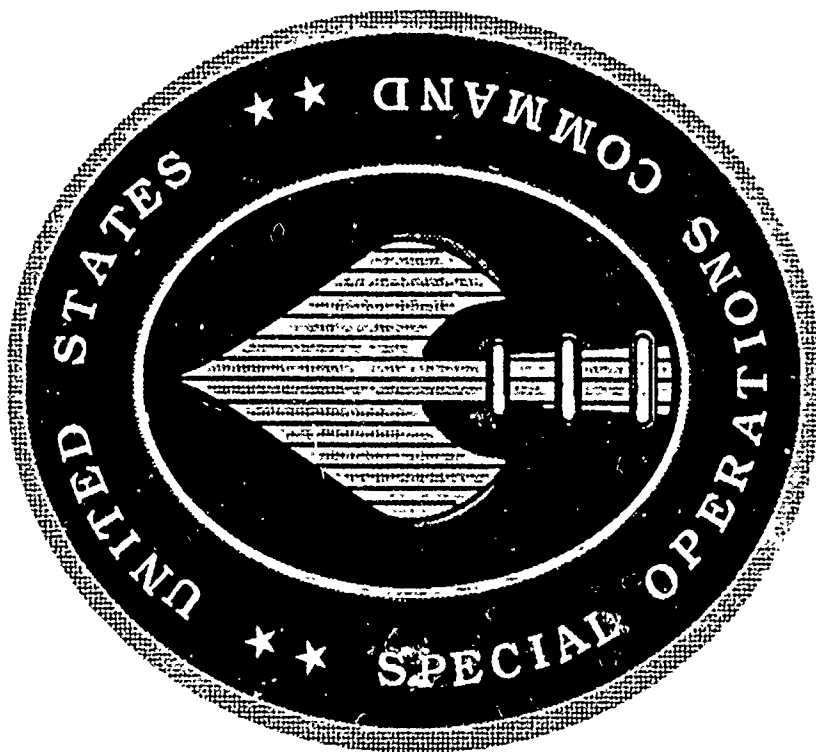
## **Summary**

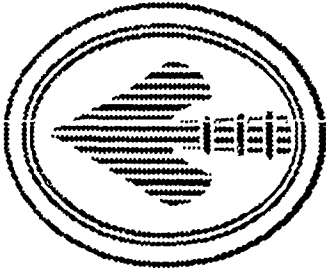
### **Project Summary**

- There Is A Major Effort By The Army To Improve The Lethality Of EFP Warheads
- Technology Programs Underway On More Powerful Explosives, Target Defeat, EFP Technology Demonstrations

### **Industrial Participation Needed In The Following Areas**

- Technology Challenges
  - Advanced Warhead Concepts
  - New High Density Liner Materials
  - Improved Material/Fracture Models
- Production Challenges
  - Improved Liner Manufacturing Processes
  - Consistent Line Material Properties





# UNITED STATES SPECIAL OPERATIONS COMMAND

JRS00DE01 03/07/2001HR

## • SUPPORTING MISSION:

— PREPARE ASSIGNED FORCES TO CARRY OUT SPECIAL OPERATIONS, PSYCHOLOGICAL OPERATIONS, AND CIVIL AFFAIRS MISSIONS AS REQUIRED.

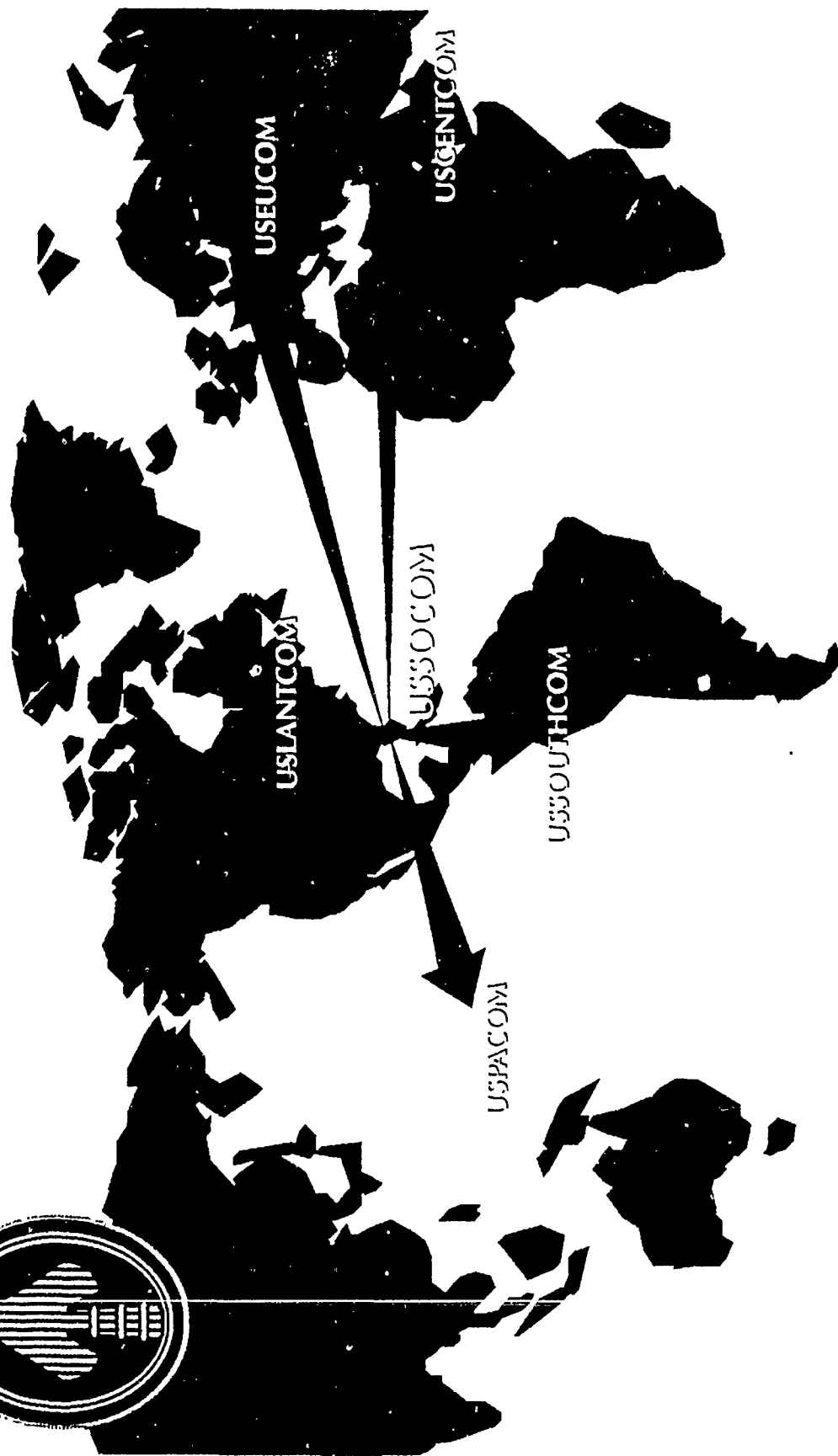
## • SUPPORTED MISSION:

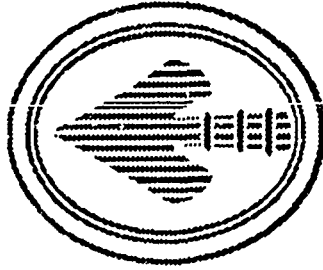
— PLAN AND CONDUCT SELECTED SPECIAL OPERATIONS, IF SO DIRECTED BY THE PRESIDENT OR SECRETARY OF DEFENSE



# GLOBAL COMMITMENT

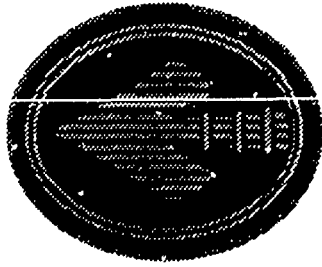
JR010616 02/13/00 EBC





# **SPECIAL OPERATIONS**

- **FOREIGN INTERNAL DEFENSE**
- **UNCONVENTIONAL WARFARE**
- **SPECIAL RECONNAISSANCE OPERATIONS**
- **DIRECT ACTION**
- **COUNTERTERRORISM**



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# SPECIAL OPERATIONS FORCES

ARMY

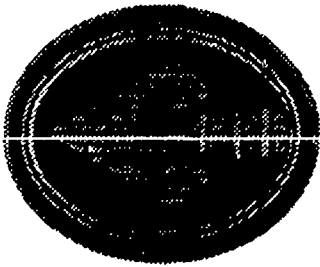
— SPECIAL FORCES

— RANGERS

— SO AVIATION

— PSYOP

— CIVIL AFFAIRS



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# SPECIAL OPERATIONS FORCES

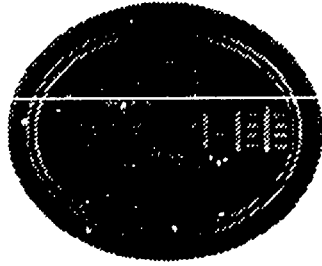
## NAVY

SEAL TEAMS

SEAL DELIVERY VEHICLE TEAMS

SPECIAL BOAT UNITS

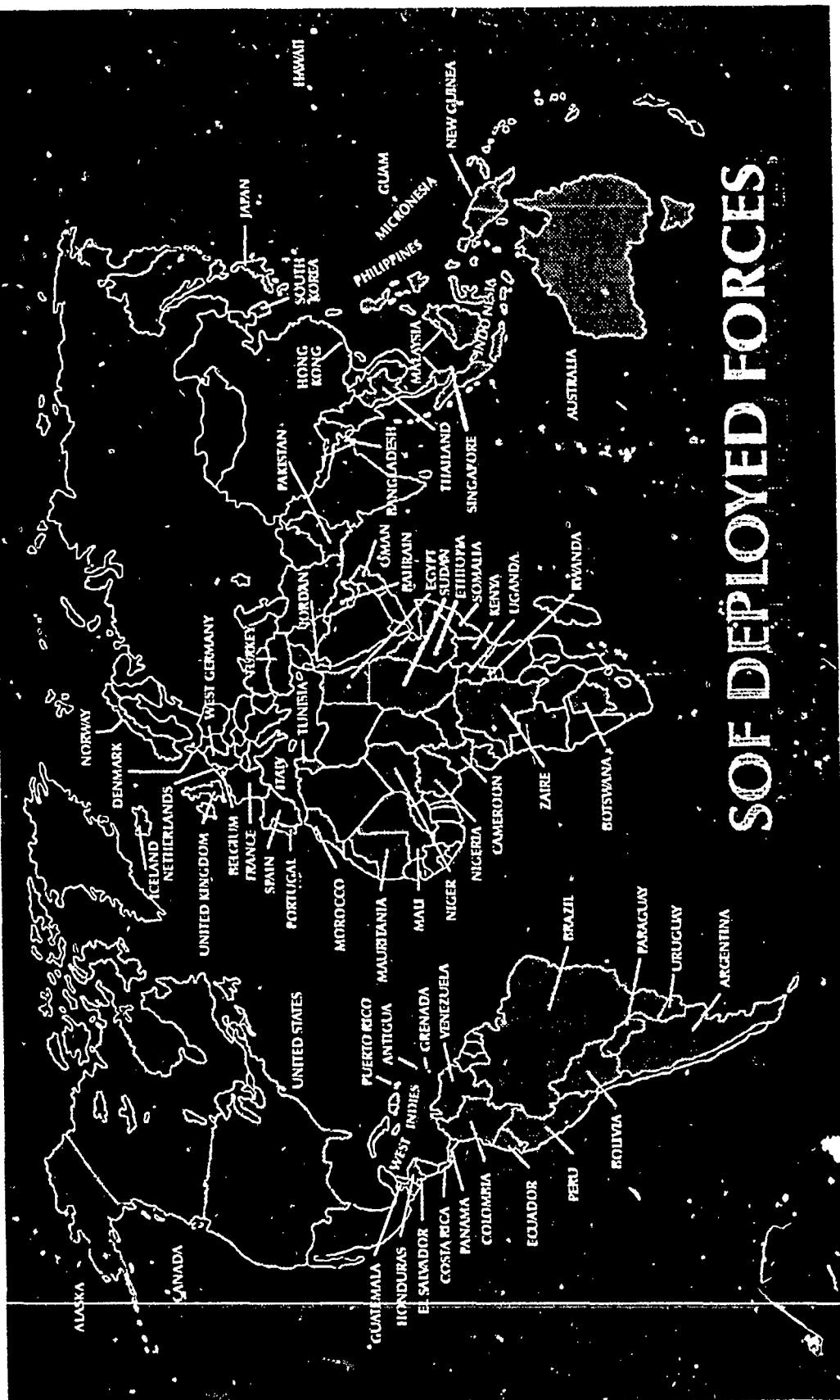


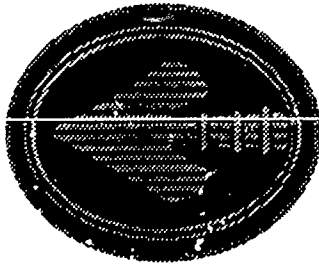


# SPECIAL OPERATIONS FORCES

ALPH 0000000000

- SO AIRCRAFT
- SUPPORT AIRCRAFT
- COMBAT CONTROL TEAMS





# USCINCSOC'S AUTHORITY

- PUBLIC LAW 100-180 PROVIDES:
  - AUTHORITY TO DEVELOP AND ACQUIRE SPECIAL OPERATIONS PECULIAR EQUIPMENT
  - AUTHORITY TO ACQUIRE SPECIAL OPERATIONS PECULIAR MATERIAL, SUPPLIES, AND SERVICES
  - USCINCSOC WITH HEAD OF AGENCY CONTRACTING AUTHORITY



USC00BF36 07/13/00/SUE

# SO-PECULIAR ACQUISITION PROCESS

## USER REQUIREMENT

USER NEEDS  
\* COMPONENT  
\* REGIONAL CINC  
TARGET/THREATS  
TECH OPPORTUNITY  
COOPERATIVE  
OPPORTUNITIES

CINCSOC

VALIDATION

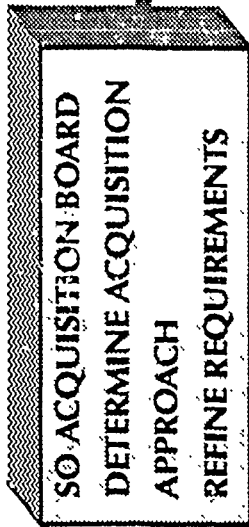
PRIORITIZATION  
(INTEROPERABILITY)



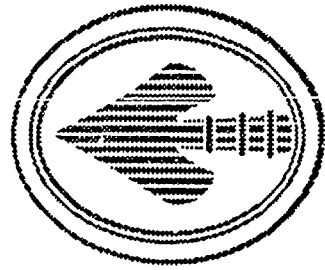
IPL



CINC'S  
SITREP

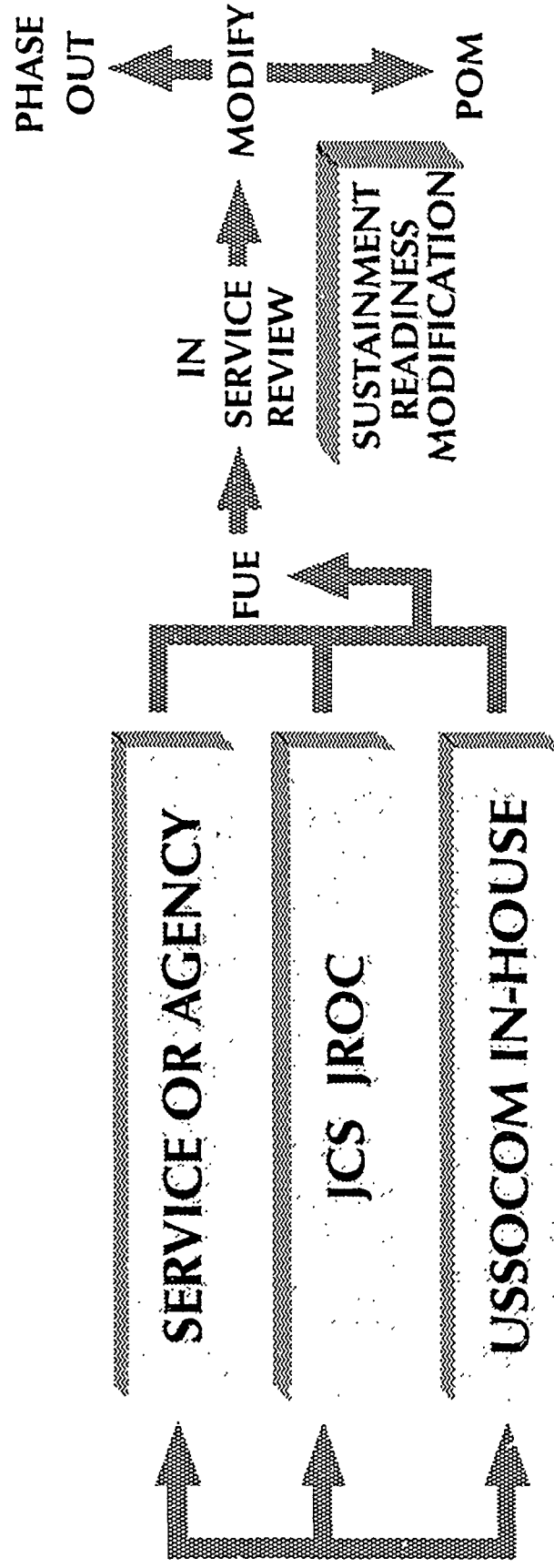


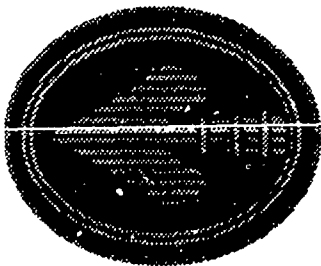
POM



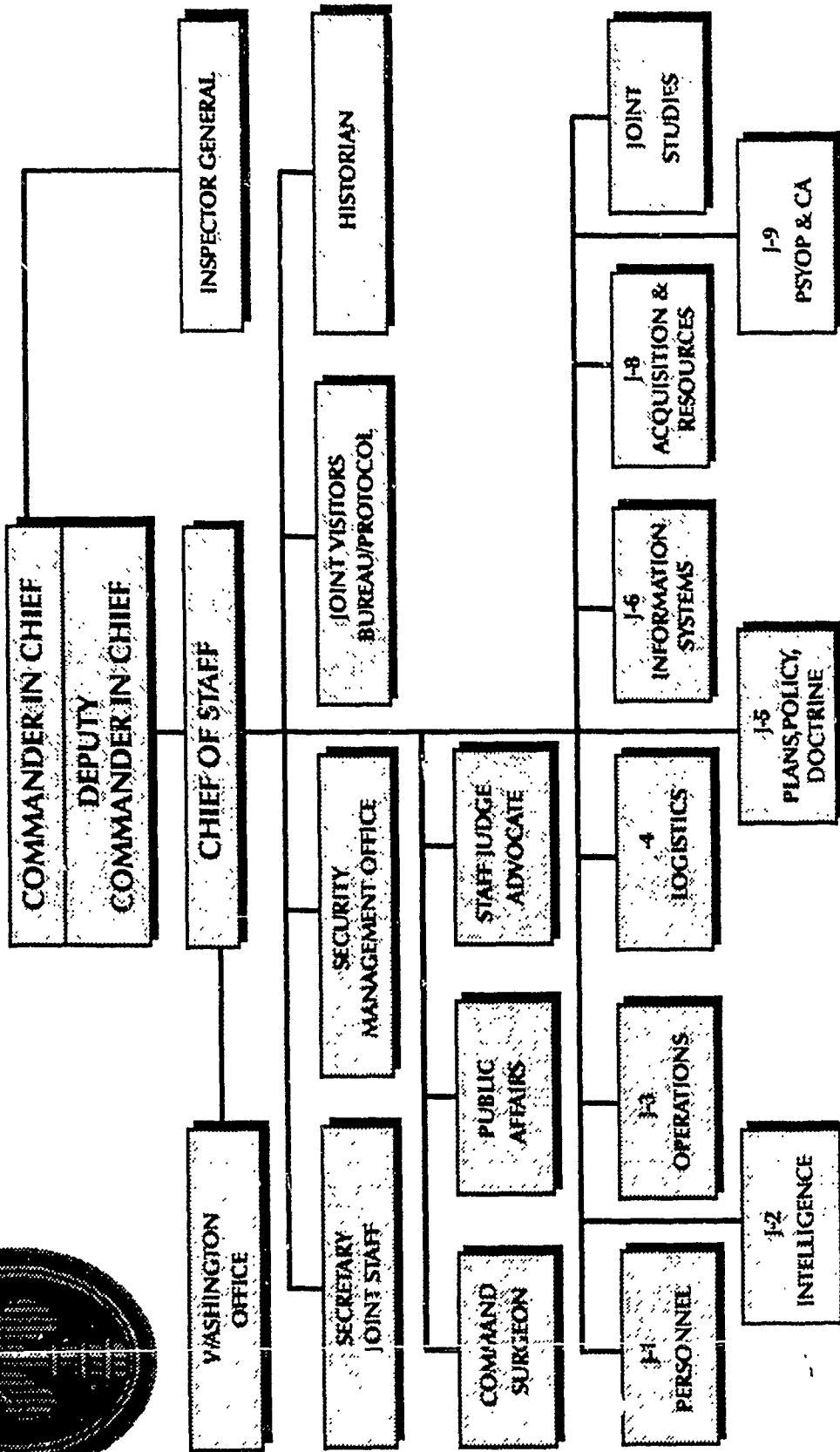
# SO-PECULIAR ACQUISITION STRATEGIES

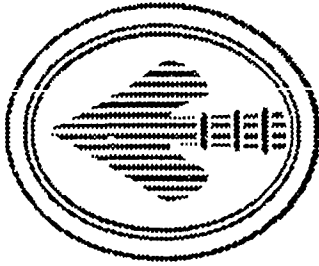
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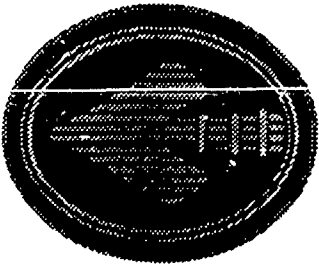
# UNITED STATES SPECIAL OPERATIONS COMMAND





## TRENDS SIGNIFICANT FOR SPECIAL OPS FORCES:

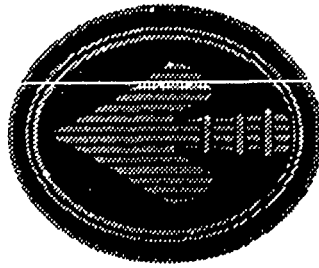
- \* THE ENEMY IS HARDER TO IDENTIFY
- \* THE ENEMY FREQUENTLY BLENDS WITH INNOCENT CIVILIANS
  - ... LESS RURAL
  - ... MORE URBAN
- \* THE ENEMY HAS A VALUE SYSTEM DIFFERENT FROM OURS
  - ... TO SOME DYING IS A DESIRABLE OUTCOME (FOR RADICAL ENEMIES)
  - ... PROFIT IS A MOTIVE (FOR CRIMINAL ENEMIES)
- \* NATIONAL INTERESTS ARE NOT CLEARLY DEFINED
- \* THE WORLD IS BECOMING MULTI-POLAR
- \* UNNECESSARY DESTRUCTION PRODUCES LONG-TERM ENEMIES
- \* MASS MEDIA SCRUTINY ..... WORLD OPINION DEMANDS "FAIR FIGHT"



## DESIRED SOF OPERATIONAL CHARACTERISTICS FOR SYSTEMS

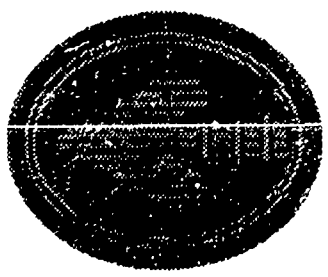
- LIGHTWEIGHT AND MICRO-SIZED
- LPI / LPD JAM RESISTANT C<sup>3</sup>
- LOW SIGNATURE / LOW OBSERVABLE
- HIGHLY LETHAL AND DESTRUCTIVE
- NEAR REAL-TIME SURVEILLANCE AND INTEL
- ELECTRONIC WARFARE CAPABLE OF DISRUPTION AND DECEPTION
- BUILT-IN SURVIVABILITY



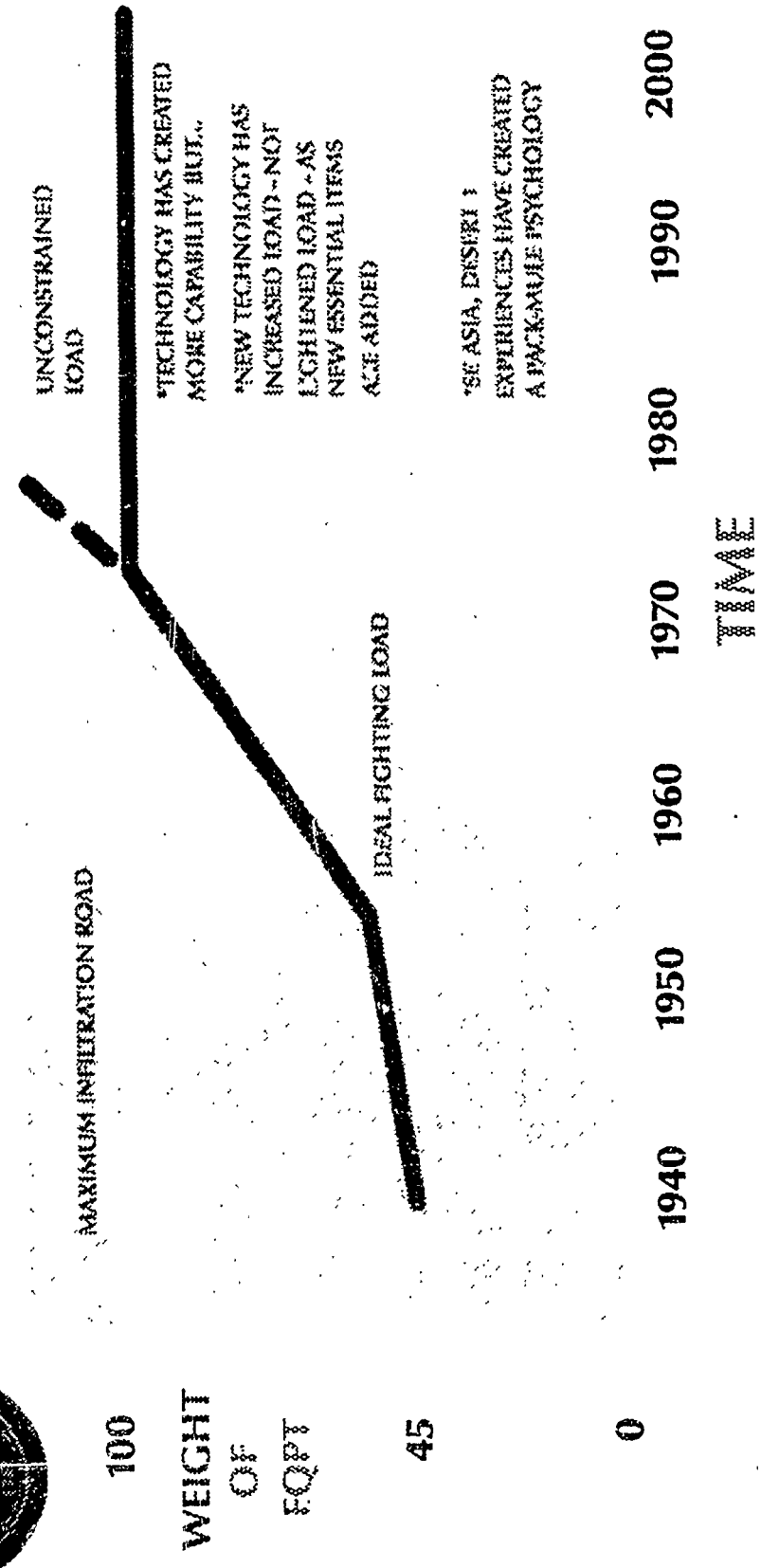


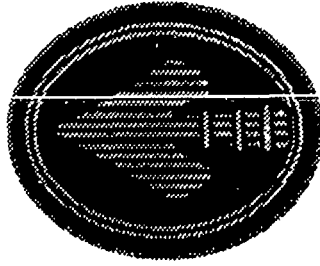
## **DESIRED SOF OPERATIONAL CHARACTERISTICS FOR SYSTEMS**

- **MODULAR, RUGGED, RELIABLE, MAINTAINABLE,  
AND SIMPLISTIC**
- **OPERABLE IN EXTREME COLD/HOT TEMPERATURE  
ENVIRONMENTS**
- **COMPATABLE WITH CONVENTIONAL FORCE  
SYSTEMS**
- **WATER DEPTH AND ATMOSPHERE PRESSURE PROOF**
- **CERTIFIED TRANSPORTABLE BY AIRCRAFT, SHIP, AND  
SUBMARINE, AND DEPLOYABLE BY PARADROP**



# SOF OPERATOR'S LOAD





# LIGHTENING THE LOAD

## ITEMS

WEIGHT/  
POUNDS

### • BOOTS

"AN OUNCE SAVED ON THE FEET  
IS WORTH 10 POUNDS SAVED ON THE BACK."

### • ARMAMENTS

8 - 16

### • AMMUNITION/DEMOLITIONS

12 - 60

### • COMMUNICATIONS EQUIPMENT/POWER SOURCES (BATTERIES)

4 - 75

eg. PRC-113(25), PRC-117(25), PRC-104(25), KY-57(10),  
TRN-47 TACAN(75), PPN-19(30)

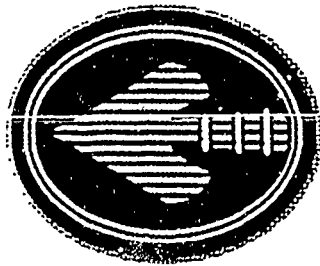
### • SENSORY ENHANCEMENT

2 - 10

- BINOCULARS    - NIGHT VISION DEVICES    - SENSORS

### • WATER

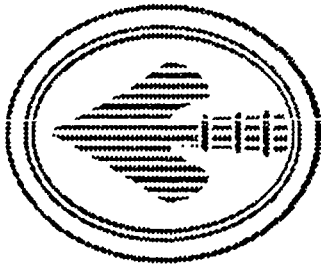
4 - 20



# LIGHTENING THE LOAD ITEMS

WEIGHT/  
POUNDS

• MEDICAL/SURGICAL ITEMS (eg. DEHYDRATED PLASMA)	4-8
• LOAD CARRYING EQUIPMENT - RUCKSACKS - HARNESES - POUCHES	5-15
• FOOD	4-8
• CAMOUFLAGE AND DECEPTION ITEMS	4
• COMFORT/ENVIRONMENTAL ITEMS (COLD WX CLOTHING)	5-30
• BALLISTIC PROTECTION	10
• DIRECTED ENERGY PROTECTION	1-2
• NBC PROTECTION	10
• PERSONAL HYGIENE ITEMS	1-2



# DESTRUCTIVE SYSTEMS

US900HB06 IMG 08127D01EBG

## LONG RANGE PERIOD

### WEAPONS

ADVANCED SNIPER RIFLES

ADVANCED CLOSE QUARTER BATTLE WEAPONS

STEALTHY UNMANNED VEHICULAR WEAPONS

ENHANCED EXPLOSIVE CHARGE

OPTICAL LASER WEAPONS

SOFT-KILL WEAPONS

## FAR FUTURE PERIOD

### WEAPONS

MINIATURE GUIDED PROJECTILES

"BRILLIANT" SMALL ARMS

DIRECTED ENERGY WEAPONS

- HPM - BEAMS  
- LASERS

NON-LETHAL/NON-DESTRUCTIVE  
INCAPACITATORS

### SENSORY ENHANCEMENT

MULTISPECTRAL INDIVIDUAL VISION DEVICES

AUDIO, GUSTATORY, OLFACTORY, AND

TACTILE ENHANCING DEVICES

SHALLOW WATER/TERRESTRIAL MINE DETECTION

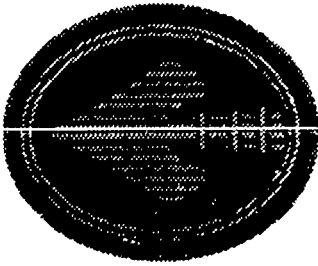
### SENSORY ENHANCEMENT

"UNDER THE SKIN"

HUMAN SENSORY ENHANCEMENT

ARTIFICIAL INTELLIGENCE AIDS  
TO TARGET RECOGNITION

MULTISPECTRAL "CONTACT LENSES"



# **SOF TECH BASE PHILOSOPHY**

## **GUIDING PRINCIPLES**

- **TAKE THE INITIATIVE**
- **BALANCE THE EFFORT**
- **FOCUS ON THE USER REQUIREMENT**
- **TECH BASE MATRIXING**
- **RESOURCE LEVERAGING**
- **PROTOTYPE TRANSITION PLANNING**
- **TECH BASE TEAMING**
- **SOF AS A TECH BASE DEMONSTRATION ENVIRONMENT**



JHHJKE2J 0500020 SUE

## SOF TECH BASE DEVELOPMENT

- COMMUNICATE SOF, PSYOP, AND CIVIL AFFAIRS  
TECH BASE NEEDS
- SEEK FUNDING AUTHORITY INCREASE
  - OSD AND ASD (SO/LIC)
  - CONGRESSIONAL SUPPORT
- FUNDING BALANCED TO EXPLOIT TECHNOLOGY
  - BASIC RESEARCH (6.1) 10%
  - EXPLORATORY DEVELOPMENT (6.2) 30%
  - ADVANCED DEVELOPMENT (6.3A) 60%



# SOF TECH BASE FUNDING

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(DOLLARS IN MILLIONS)

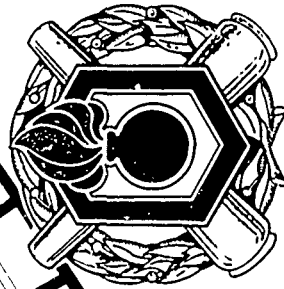
NOTES	TITLE	91	92	93	94	95	96	97
1, 2	SO TECH DEVELOPMENT (6.1, 6.2, 6.3A)		3.0 (36.0)	3.0 (34.0)	4.5 (33.0)	12.5 (27.0)	12.5 (28.0)	16.5 (25.0)
1	SPEC OPS SPEC TECH (6.3A)	9.4	9.7	10.1	10.5	10.5	10.5	11.5
1	SO MEDICAL RESEARCH (6.2, 6.3A)		.30	.55	.55	2.05	2.05	2.05
3	EOD-LIC (6.3A)	5.0	5.0	5.0	5.0	5.0	5.0	5.0
4	OSD BTI (6.3A)	40.8	2.0 (28.0)	0 (70.0)	0 (40.0)	0 (11.0)		

NOTES: 1: PARENS INDICATE POM ADDENDUM SHORTFALLS  
2: FY 92-97 DOLLARS BASED ON USSOCOM POM  
3: EOD-LIC ADMINISTERED BY ASD(SO/LIC)  
4: OSD BTI ADMINISTERED BY DR&AT



**Advanced  
Planning  
Briefing for  
Industry**

**DECADE OF  
CHANGE  
90'S**



**Armament Challenges for  
the 1990's . . .**

**Special Operations/  
Low Intensity Conflict  
(SOLIC)  
Initiatives**

PRESENTED BY

**CPT GIL BROWN**

ADVANCED SYSTEMS CONCEPTS OFFICE  
724-5911/3218

# ***Objectives***

- Apprise Industry Of ARDEC Efforts In Support Of Special Operations Initiatives
- Indicate Areas Of Future Opportunities
- Expand Industry Vision Of Operational Needs To Include Special Operations Forces

# ***On-Going Projects***

- Leaflet Artillery Round (LAR)
- Ranger Anti-Armor/Anti-Personnel Weapon System (RAAWS)
- RAAWS Ammunition
- Selectable Light Weight Attack Munition (SLAM)
- Time Delay Firing Device (TDFD)
- Penetration Augment Munition (PAM)
- Pursuit Deterrent Munition (PDM)

## ***Funding***

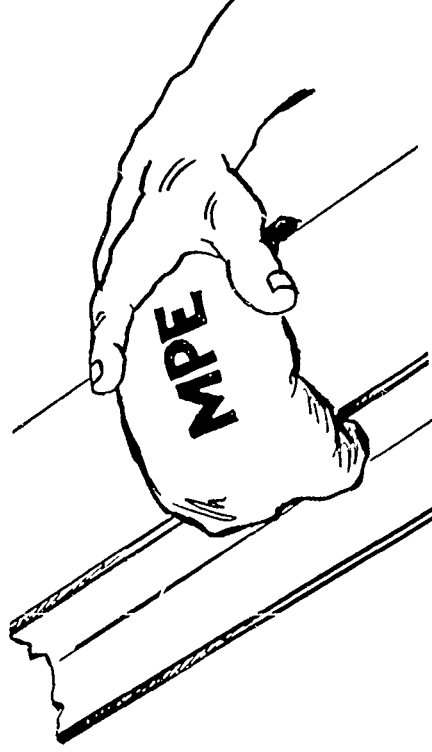
FY	90	91
\$ (M)	16*	16*

\* Does Not Include LAR Funding Increase Nor PDM Estimates

# ***Future Opportunities***

- Small Arms
- Packaging
- More Powerful Explosives
- Advanced Sensors
- Adhesives

# More Powerful Explosives



## Capability Issue/Deficiency:

- Inadequate Capability To Breach Minefields/Complex Obstacles
- Need:
- Increased Explosive Capability Within Man-Pack Constraints

## Technology/Approach:

- Explosives Synthesis, Technology
- Insensitive Explosive Technology

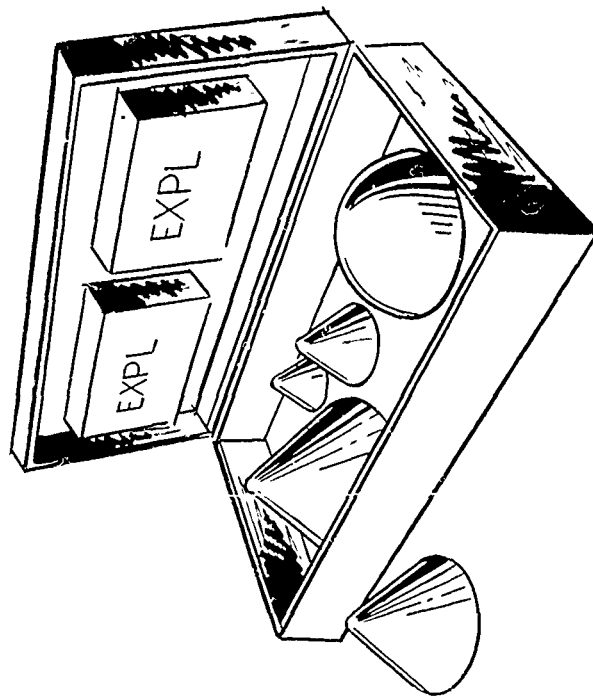
## Payoff/System Applications:

- Replacement Of RDX/C-4 With More Powerful Explosive
- Same Destructive Capability (Less Weight/Volume)
- Increased Capability (Same Wt/Cube)

# Family Of Small Arms

<p><b>Description:</b></p> <ul style="list-style-type: none"> <li>● Highly Advanced Family Of Individual Small Arms And Crew Served Weapons</li> <li>● Night/Obscured Vision Target Acquisition</li> <li>● Laser Pistol</li> <li>● Weapon Projection Of Microwave, Light, Sound, Particle Beam And Non-Lethal Vapors</li> </ul>	<p><b>Capability Issue/Deficiency:</b></p> <ul style="list-style-type: none"> <li>● Inadequate Capability Of Light Forces To Move With Required Combat Load</li> </ul> <p><b>Need:</b></p> <ul style="list-style-type: none"> <li>● A Need Exists For Advanced Small Arms To Support S.O. Activities Related To Unconventional/Conventional Warfare, Counterterrorism, Counter Narcotic And Other Covert Operations</li> </ul>
<p><b>Technology/Approach:</b></p> <ul style="list-style-type: none"> <li>● Composite Materials For Lighter Weight And Greater Strength</li> <li>● Small Arms "Lethality Mechanisms"</li> <li>● Adaption Of Technologies (Directed Energy, Microwave, etc)</li> </ul>	<p><b>Payoff/System Applications:</b></p> <ul style="list-style-type: none"> <li>● Improved Effectiveness, Lethality</li> <li>● Lighter Weight</li> <li>● Improved Day/Night Performance</li> </ul>

# Packaging



### Capability Issue/Deficiency:

- Inadequate Capability To Sustain Logistics Operations In LIC
- Inadequate Survivability Of Personnel, Equipment And Support Systems

### Need:

- Rugged Containers
- Lighter Load
- Increase Storage Life
- Resealable Package

### Technology/Approach:

- Utilize Lt. Wt Metal
- High Density Polyethylene And Polypropylene As Packaging Material
- Screw Caps In Lieu Of "Key Tabs" (Resealable)

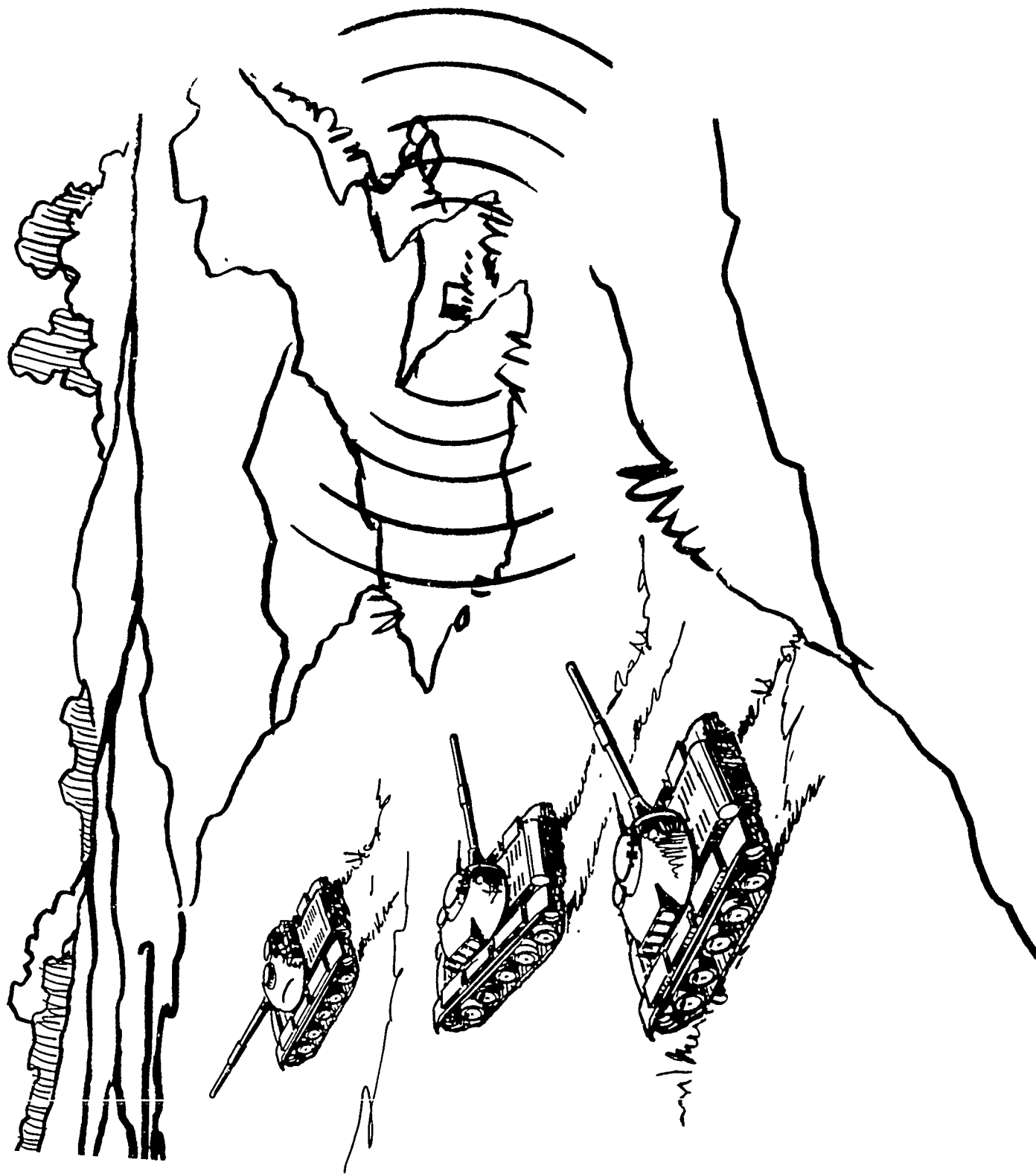
### Payoff/System Applications:

- Reduction In Weight (Soldiers Load)
- Resealable Package
- Improved Storage Life
- Reduced Maintenance
- Reduce Cost
- Environmental Protection

# Family Of Advanced Sensors

<p><b>Description:</b></p> <ul style="list-style-type: none"> <li>● A Family Of Multi-Functional (Personnel, Vehicle And Helicopter) Sensing Devices</li> <li>● Non-Line-Of-Sight Detecting</li> <li>● Identification, Classification And Tracking</li> <li>● Basic Intelligence Gathering</li> <li>● On-Off Arming Capability</li> <li>● Acoustic, Pressure, Temp; Anti-Photo, Magnetic, Barometric Sensors/Arming</li> </ul>	<p><b>Need:</b></p> <ul style="list-style-type: none"> <li>● "Identification Of Friend-or-Foe" (IFF)</li> <li>● Modular Kit</li> <li>● Arming/Disarming/Neutralization</li> <li>● Light Wt/Long Life</li> <li>● Central Control</li> </ul>
<p><b>Technology/Approach:</b></p> <ul style="list-style-type: none"> <li>● Sensor Fusion</li> <li>● New And Unique Sensor Concepts</li> </ul>	<p><b>Payoff/System Applications:</b></p> <ul style="list-style-type: none"> <li>● Command And Control</li> <li>● Intelligence Gathering</li> <li>● Enhanced Target Acquisition</li> <li>● Real Time Battle Management</li> </ul>

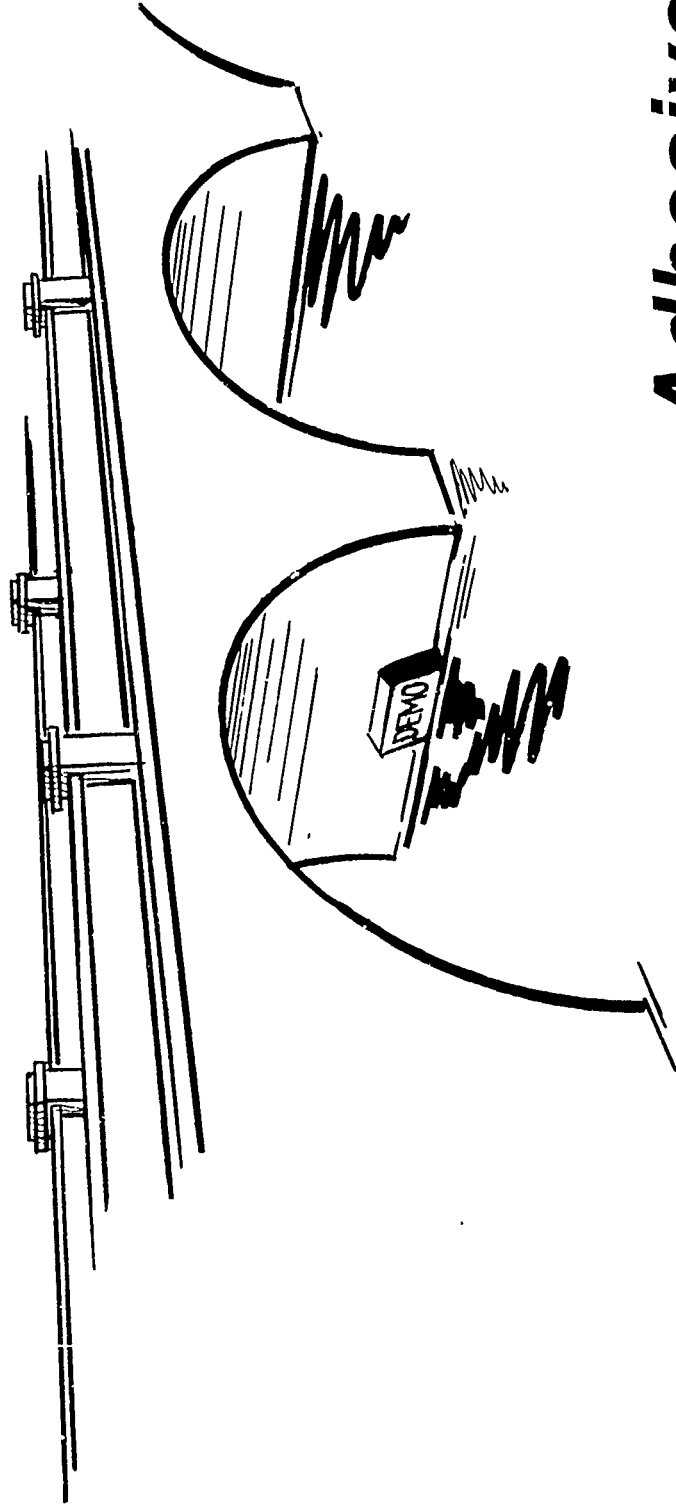




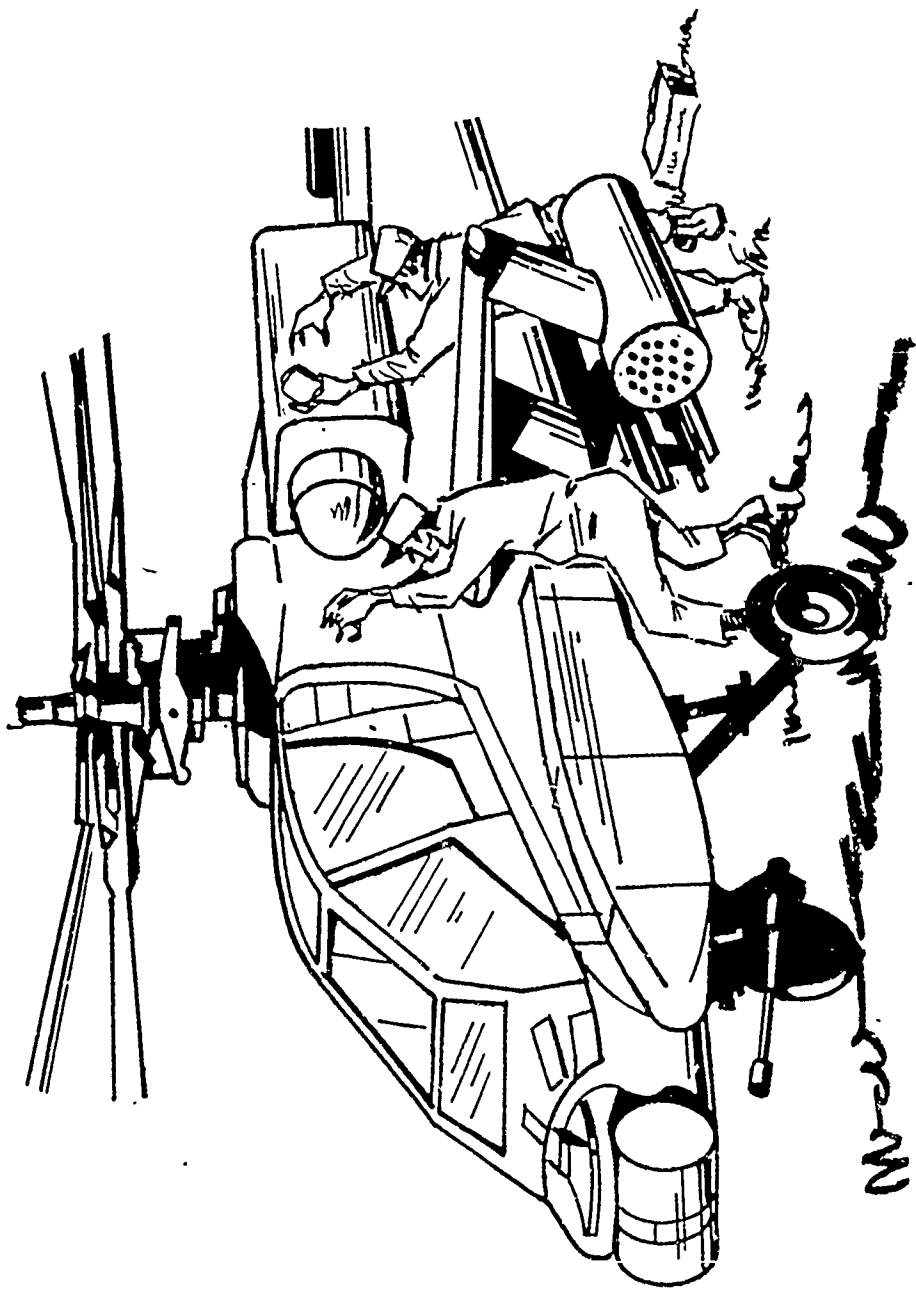
# Adhesive Systems

<p><u>Description:</u></p> <ul style="list-style-type: none"><li>● Multi-Purpose Bonding Kit</li><li>● Bonding Of Demol Blocks To Metal, Wood, Concrete, Plastic Structures/Vehicles</li><li>● Must Be Useable Underwater/Rusty, Rough Surfaces</li><li>● Adhesive Systems For Rapid Field Secondary Repair Of Helicopters, Bridging, Vehicles, etc</li></ul>	<p><u>Capability Issue/Deficiency:</u></p> <ul style="list-style-type: none"><li>● Inadequate Capability To Fix, Maintain Equipment Needed In The Battlefield</li></ul> <p><u>Need:</u></p> <ul style="list-style-type: none"><li>● Special Operations Forces (SOF) Desires Multi-Purpose (Family) Of Adhesives</li></ul>
<p><u>Technology/Approach:</u></p> <ul style="list-style-type: none"><li>● New Adhesives Technology</li><li>● Environmental Conditions - High Temp, Humidity, Cold Temp, etc</li><li>● Application Of Acrylics And Epoxies</li></ul>	<p><u>Payoff/System Applications:</u></p> <ul style="list-style-type: none"><li>● Mines/Demolitions For SOF Applications Could Be Supplied Pre-Coated With Adhesives</li><li>● Improved Maintainability/Availability Of Equipment</li></ul>

SOF



**Adhesives**



# ***Challenges To Industry***

- **Light Weight**
- **Increased Effectiveness And Lethality**
- **Increased Destructive Capability**
- **Enhanced Threat Acquisition/Identification**
- **Improved Operational Availability**

# **Summary**

**Light , Lethal**

**1991**

**APBI Preview**

**Armaments For The  
21st Century**

PRESENTED BY

**Ms. RENATA PRICE**

DEPUTY DIRECTOR  
CLOSE COMBAT ARMAMENTS CENTER  
724-7905

# ***Close Combat Mission***

## ***"A Challenging Environment"***

- Spontaneous Reaction
- Time Critical
- Widely Dispersed
- Sustained Operations In Hostile Environment
- Direct & Residual Combat Action



# **Close Combat Mission**

## **Combat Vehicles**

- COMVAT
- SAMM
- Autoloaders

490E2-PH

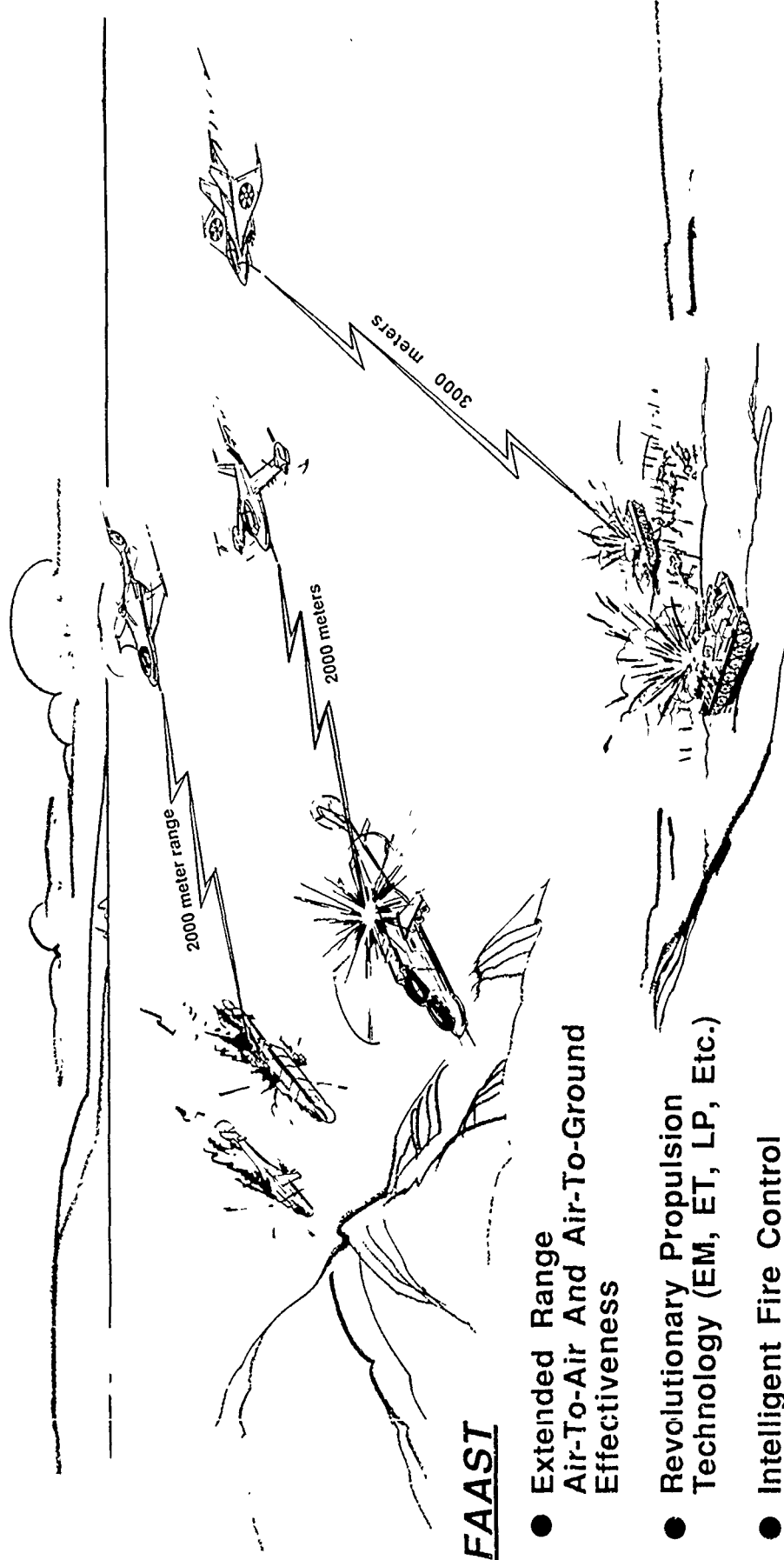
# **==Close Combat Mission==**

## **Aviation**

- HIPAS/SEAS
- FAAST

490E3-PH

# **Future Aircraft Armament System Technology**



## **FAAST**

- Extended Range Air-To-Air And Air-To-Ground Effectiveness
- Revolutionary Propulsion Technology (EM, ET, LP, Etc.)
- Intelligent Fire Control
- Technology Insertion Into Future Attack Air Vehicle (FAAV)

490E4-PH

# ***Joint Services Medium Caliber Automatic Cannon Technology (JMAT)***

- Consolidates DoD Medium Caliber Automatic Cannon Efforts
- Emerging Management Strategy
- Potential FY91 Implementation

# **Close Combat Mission**

## **INFANTRY/SPECIAL OPERATIONS**

### **Soldier Modernization Plan**

- Apply & Integrate State Of The Art Technologies
- Produce A System With Synergistic Improvements In Combat Effectiveness
- Treat The Soldier As A Major System
- Utilize The Block-Modernization Concept

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# The Future

## Technology Challenges

- Improve Anti-Armor Lethality
- Establish Superior Air-To-Air Capability
- Vastly Improve Hit/Kill Ratio For Individual/Crew Served Systems
- Enhance Man/Vehicle Survivability
- Significantly Reduce Round-To-Round Dispersion
- Thermal Management To Mediate Thermal Load Imposed By High Fire Delivery Rates

# The Future

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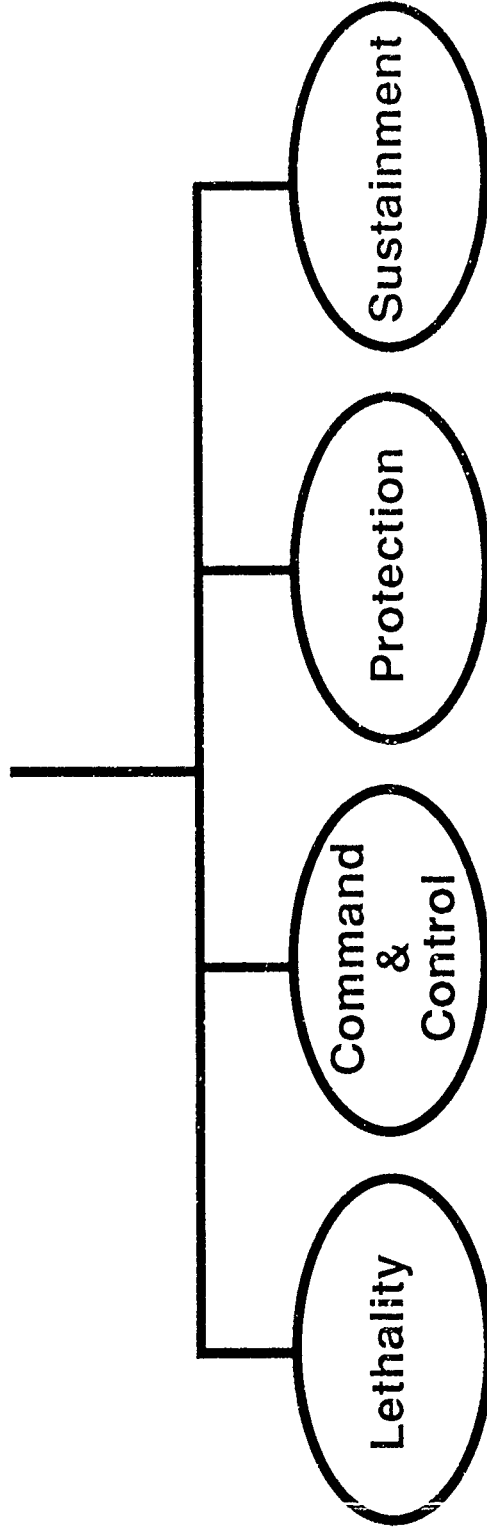
# **The Future**

## **Technology Thrusts**

- View Individual Soldier As A System
- Telescoped Ammunition (Ground-To-Ground, Ground-To-Air, Air-To-Air, And Air-To-Ground)
- Dual-Role Armament Systems
- Bursting Munitions
- Optical Munitions
- Advanced Propulsion
- Short Time-Of-Flight
- Improved Man-Portable Munitions For Fighting In Urban Terrain
- Increased Fire Delivery Rates
- Advanced Small Arms For The Individual Combatant

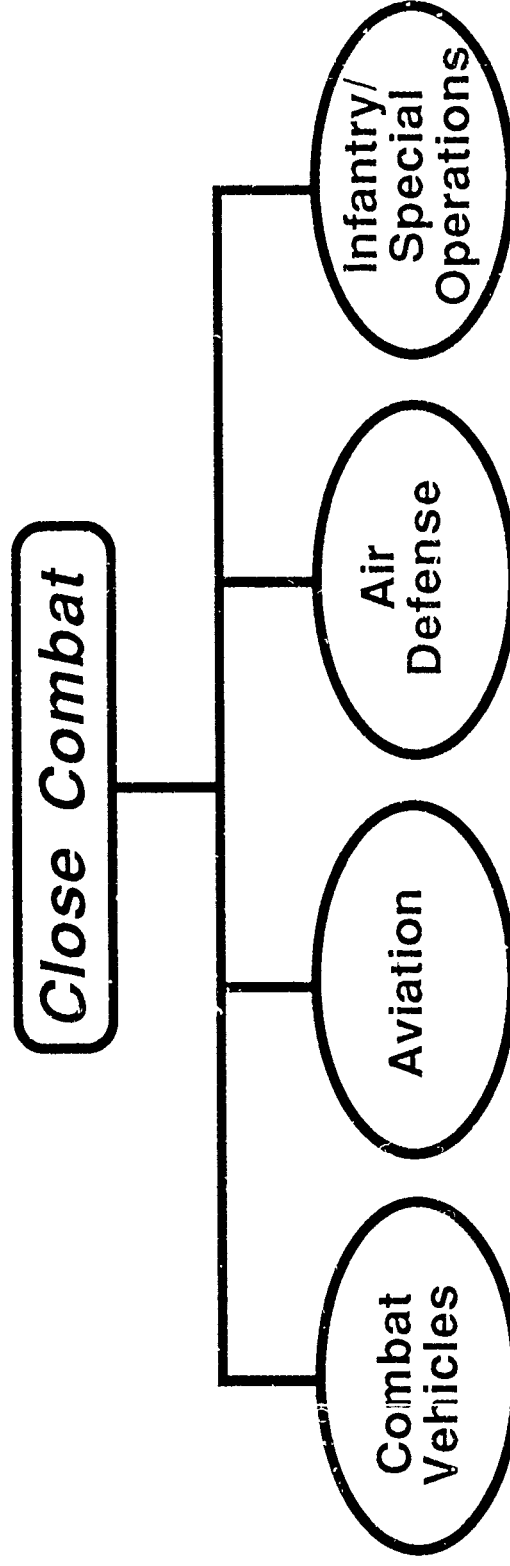


# **== Soldier Modernization Plan ==** **(SMP)**



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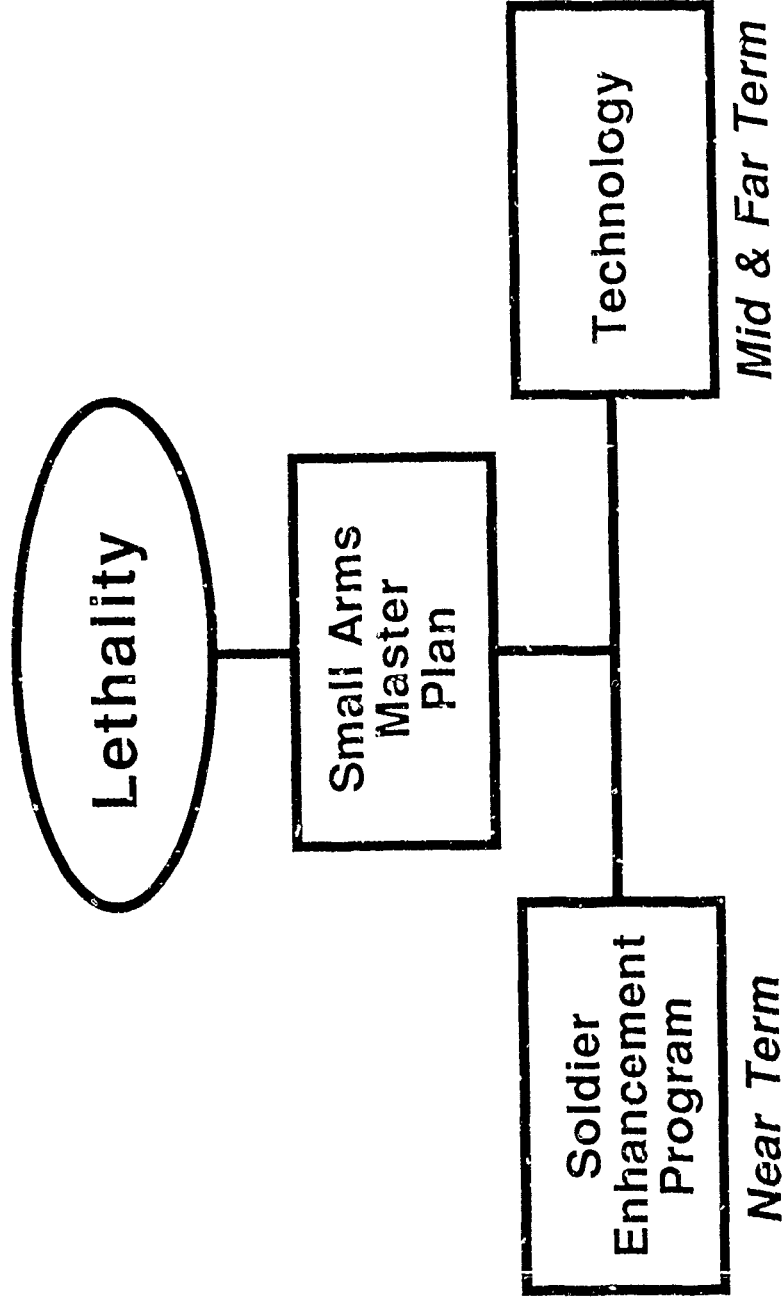
# Systemic Thrusts



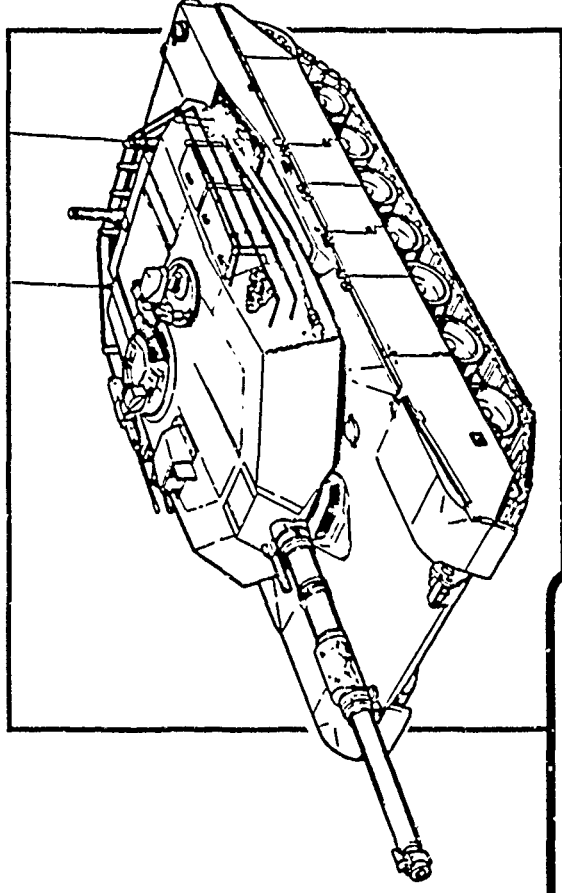
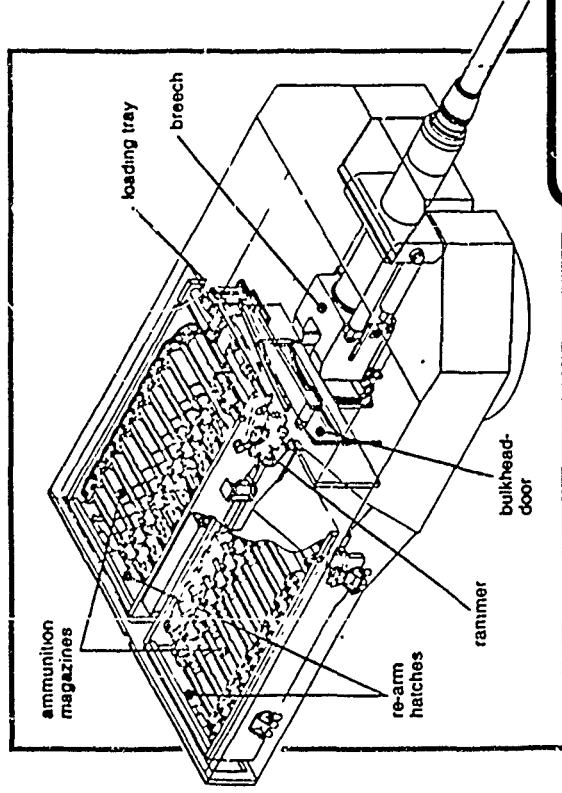
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# **==Soldier Modernization Plan==**

## **CCAC Role**



# Generic Autoloader Technology



## OBJECTIVE

### Exploit Technology

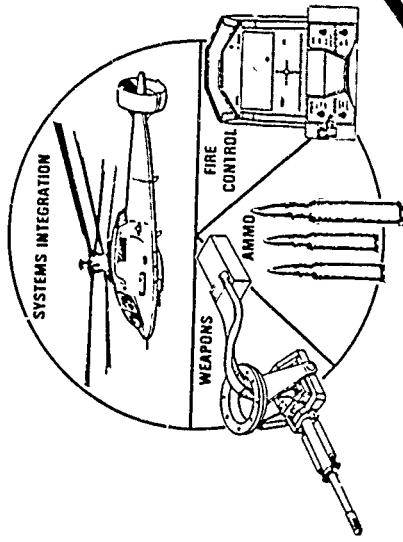
- Adaptive Controls
- Sensor Fusion
- Structural Dynamics
- Durability

### Transfer Technology To

- Conventional
- Electromagnetic
- Electro Thermal/Chemical
- Liquid Propellant
- Other Gun Systems

# High Performance Armament System

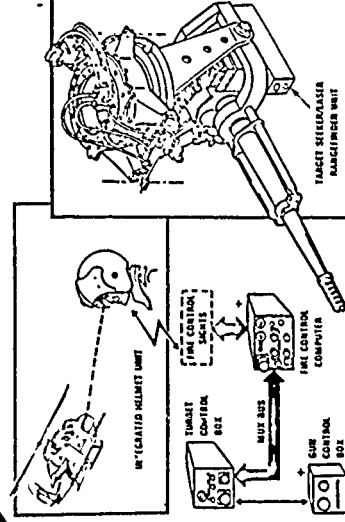
## HIPAS



- Dual Role Gun System (Air-To-Air, Air-To-Ground)
- Threat Defeated With One Short Burst

## SEAS

- Simultaneous Engagement Of Ground And Air Targets
- Quick Reaction Time
- Back Up Gun Control System
- Technology Insertion Into Apache Improvement And LH P31 Programs

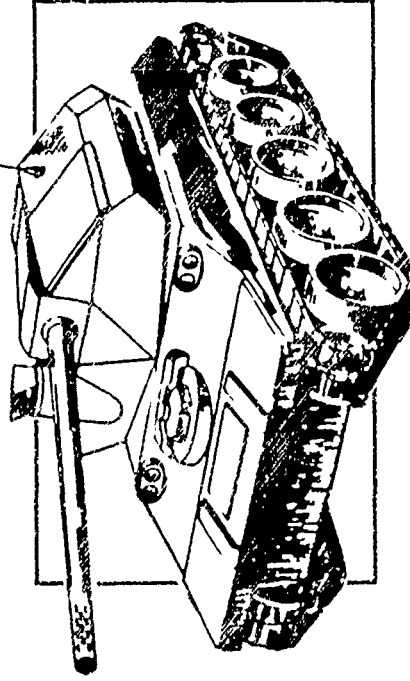
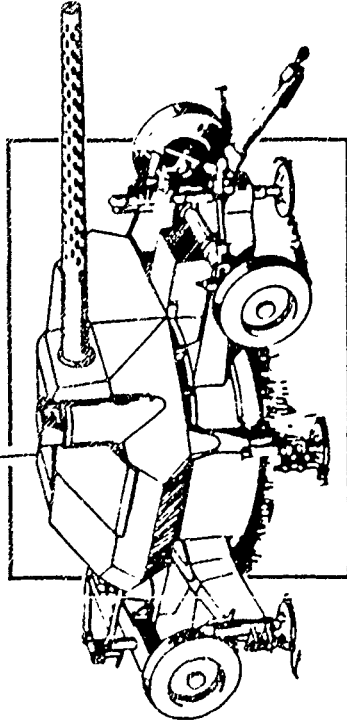


- Technology Insertion Into Apache improvement And LH P31 Programs

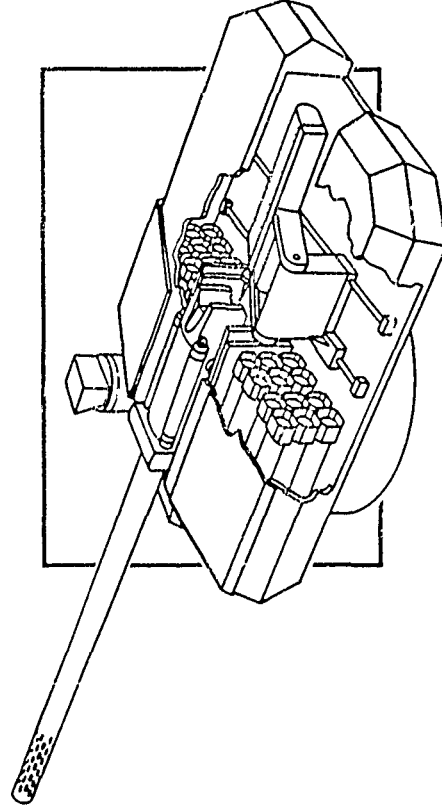
## Simultaneous Engagement Armament System

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# Semi-Autonomous Mission Modules

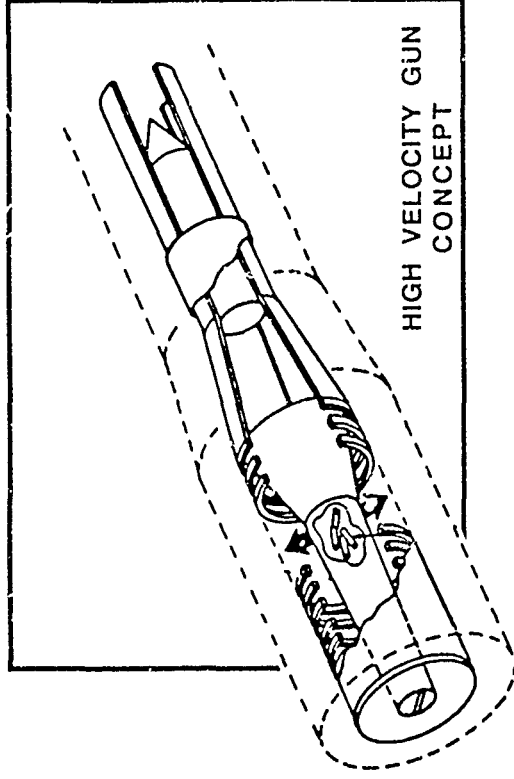
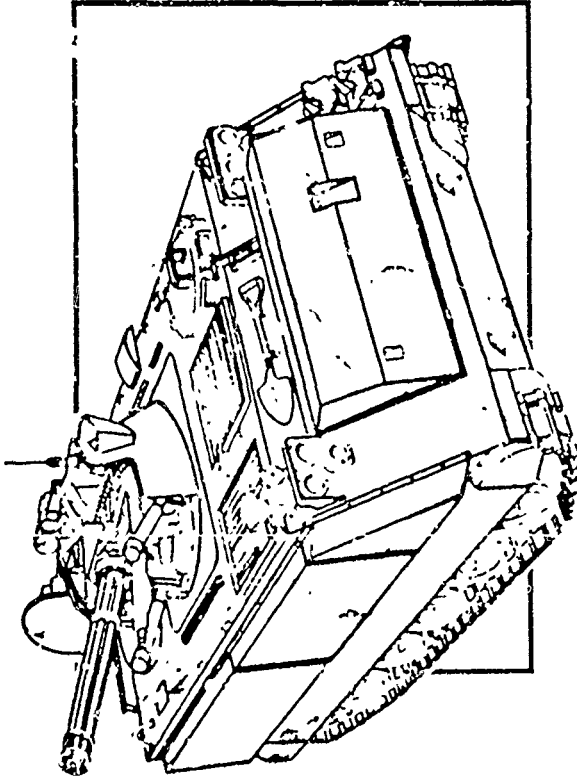


- External 105mm Cannon
- Compartmentalized Ammo
- Two Man Operation
- On/Off Board Control
- Auto-Acquisition & Track
- Acoustic Detection & I.D.
- Automatic Loading
- Autonomous Overwatch



493E15-PH

# Air Defense



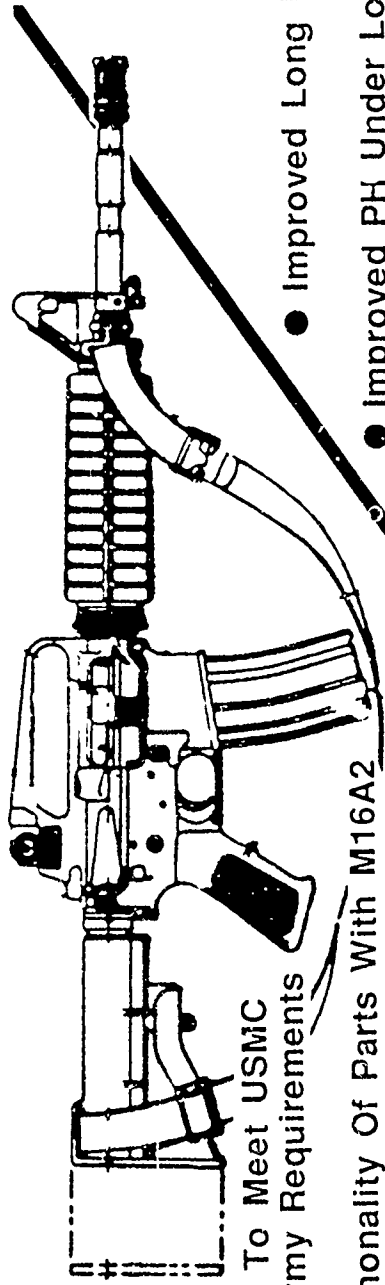
## CHALLENGES

- Defeat Tactical Ballistic, Anti-Radiation And Cruise Missiles At Extended Range To 10K And Beyond
- Provide An Air Defense Capability To The BFV And FIFV, And A Ground And Air Defense Gun Capability To The ADATS Missile System

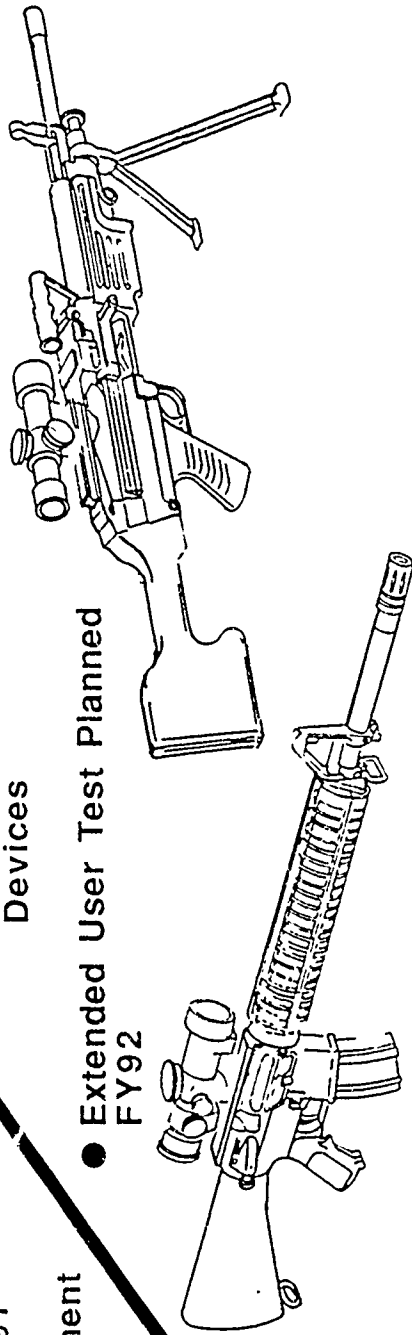
## THRUSTS

- High Velocity Propulsion System 3km/Sec - 5km/Sec Projectile With Autonomous Search, Acquisition & Command Guidance
- Parametric Study Comparing Recoil, Turret Space, Ph/k For Candidate Guns

# **XM4 Carbine**



- Developed To Meet USMC And US Army Requirements
- 80% Commonality Of Parts With M16A2
- Shorter, Lighter Version Of M16 A2 Rifle
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- Army Type Classification Planned 1st QTR FY91
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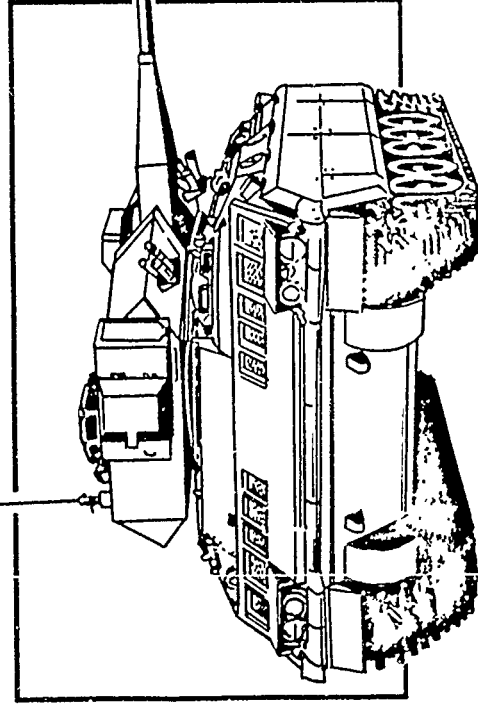


## **Optical Sights For Light Weapons**

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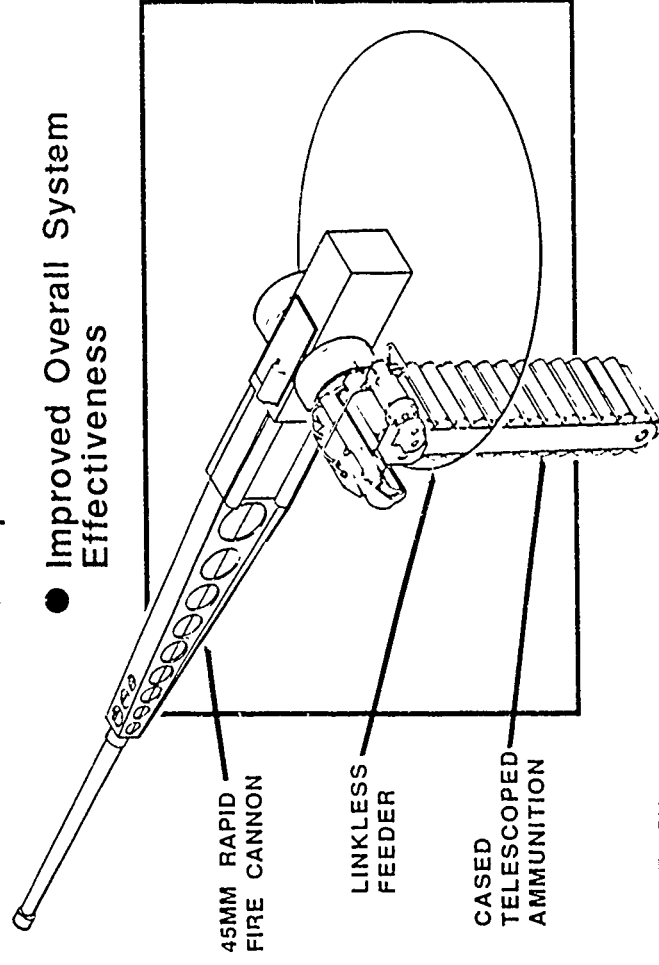


## Technology Developments



### Payoffs To The Army

- Improved Survivability
- Minimized Mission Costs
- Rapid Rearm Capability
- Improved HE Effectiveness
- Improved Overall System Effectiveness



### Industry Challenges

- Insensitive Munitions (IM) Formulations
- Low Cost Ammunition Designs
- Advanced Rearm Technologies
- Remote Set Electronic Time Fuzing

490E18PH

# ==Objective Family Of Small Arms==

## Individual Combat Weapon



- Leap Ahead Gain  
In PH Out To 1000m
- Lightweight
- Fire Bursting And/Or  
Kinetic Energy Rounds
- Modular Day/Night  
Fire Control

## Crew Served Weapon



- High PH And PS  
Out To 2000m
- Defeat Light Armor  
Out To 1000m
- Defeat Personnel  
In Fortification
- Two-Man Portable
- Modular Day/Night  
Fire Control

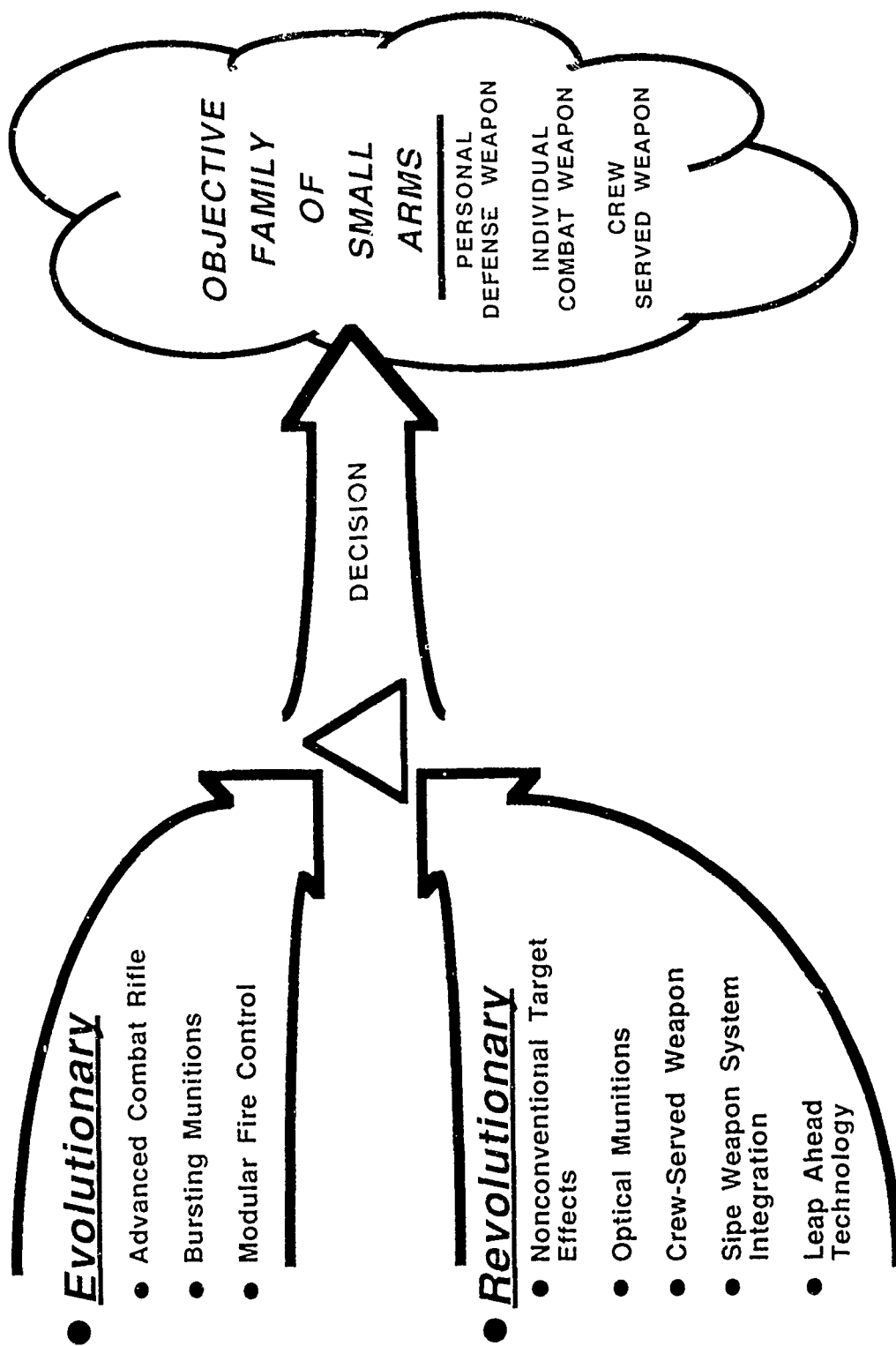
## Personal Defense Weapon



- High PH Out To 100m
- Lightweight
- Quick Acquisition/  
Fire Control

# Small Arms Master Plan

## Technology Build



# Close Combat Armaments Center

## HEADQUARTERS

TECHNICAL SUPPORT  
OFFICE

PROGRAM OFFICE

ASSOCIATE TECHNICAL  
DIRECTORS

JSSAP OFFICE

SYSTEMS  
INTEGRATION  
DIVISION

HEAVY  
ARMAMENTS  
DIVISION

LIGHT  
ARMAMENTS  
DIVISION

BENET  
WEAPONS  
LABORATORY

- Program Management
- Systems Integration For:
  - Close Combat
  - Air Defense
  - Aviation
- Systems Analysis
- Effectiveness Studies
- Safety Investigations
- Simulation Modeling
- Life Cycle Engineering For:
  - Tank Ammunitions
  - Rocket/Missile Warheads
  - Reactive Armor
- Productivity For:
  - Direct/Indirect Fire Munitions
  - Pollution Abatement
- Life Cycle Engineering For:
  - Small Arms Weaponry
  - Automatic Cannon Gun Systems
  - Ammunition Ware Simulation Facility
  - North Atlantic Regional Test Center
- Life Cycle Engineering For:
  - Artillery And Tank Cannons
  - Mortars And Recoiless Rifles
  - Mounts And Recoil Mechanisms
  - Autoloader
  - Research
  - Materials
  - Coatings
  - Physics
- Support For Watervliet Arsenal, NY

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# CCAC Mission

*The CCAC Is  
Responsible For:*

- Research Development  
And Engineering (RD&E)
- Technical Life Cycle  
Responsibility

*With Respect  
To:*

- The Complete  
Weapon  
Platform

*For:*

- Automatic Cannons
- Small Arms
- Tank And Combat  
Vehicle Armaments
- Anti-Tank Weapons
- Air Defense/Aircraft  
Guns And Cannons

*To Include:*

- Training Devices
- System Analysis
- Ancillary Equipment
  - Diagnostic
  - Test
- Packaging & Packing

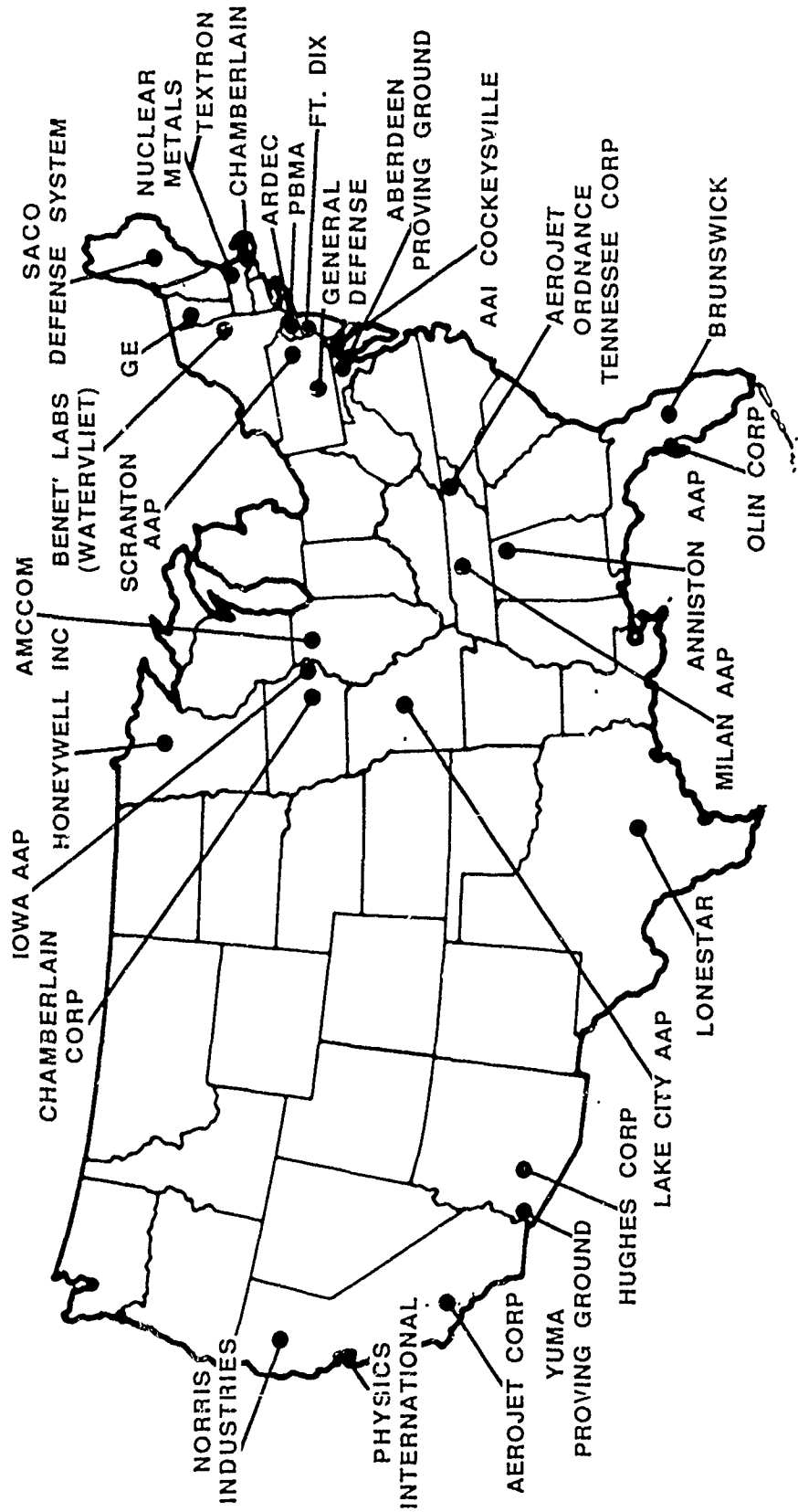
# Product Line Application

<b>M60 TANK</b> — M68-105MM CANNON — M240 COAX — M85 CAL .50 — AMMUNITION — MOUNTS — SECONDARY ARM FEEDERS — APPLIQUE ARMOR	<b>M1/M1A1 TANK</b> — M68/M256 CANNON — M240 COAX — M2 CAL .50 — AMMUNITION — MOUNTS — SECONDARY ARM FEEDERS — AEI	<b>M2/3 BFVS</b> — M242-25MM AUTOCANNON — M240 COAX — M231 FIRING PORT WEAPON — AMMUNITION — MOUNTS — FEED SYSTEM	<b>M113</b> — M2/M85	<b>ASM</b> — SAMM — ATACS — COMVAT	<b>DISMOUNTED WEAPONS</b> — M16A2 — M60 MG — SAW — M9 BAYONET — AMMUNITION — M9 PISTOL — MK19
<b>COBRA</b> — M197-20MM — HELFIRE — 2.75" ROCKET — TOW — PIP HYDRA 70 ROCKET	<b>APACHE</b> — M230 .IM — HELFIRE — 2.75" ROCKET	<b>BLACK HAWK</b> — M60 MG — AMMUNITION — PINTLE MOUNT	<b>CHINOOK</b> — M60 MG — AMMUNITION — DOOR MOUNT — REAR MOUNT	<b>IROQUOIS</b> — M60 MG MOUNT & FEED — M2 CAL .50 DOOR MOUNT	<b>FAAV</b> — PAACE — WEAPON STAB & CONTROL — HIPAS — SEAS — FAAST
		<b>LHX</b>			

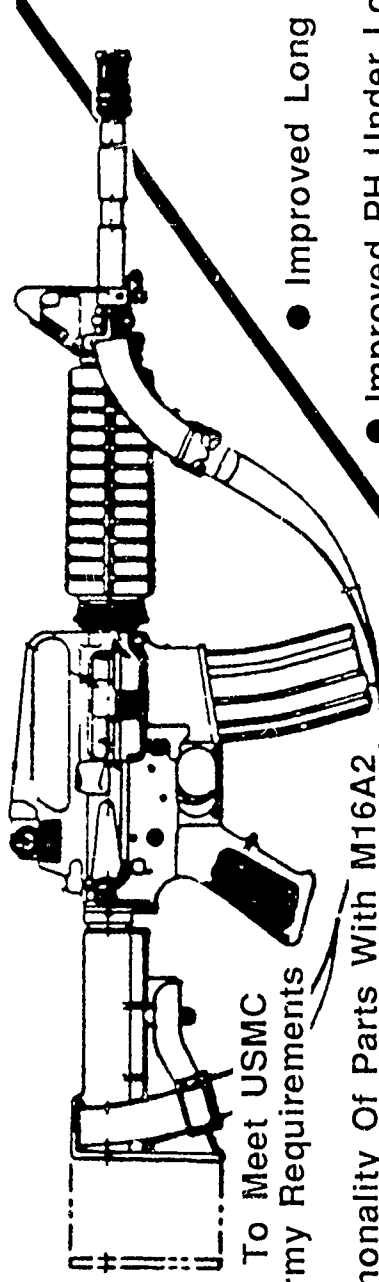
— M256 E2 LIGHTWEIGHT 120MM  
— XM91 AUTOLOADER

BLOCK III

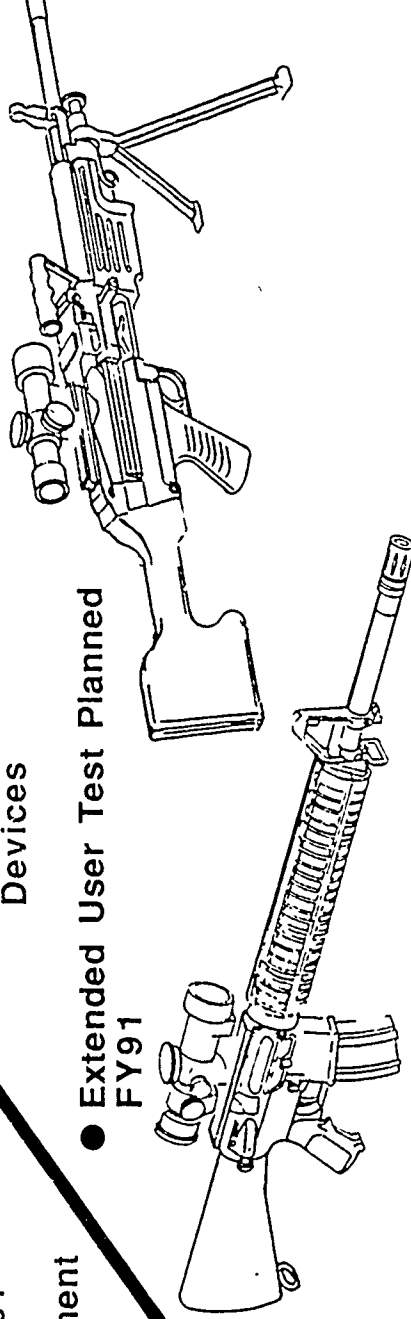
# Engineering Support



# **XM4 Carbine**



- Developed To Meet USMC And US Army Requirements
- 80% Commonality Of Parts With M16A2
- Shorter, Lighter Version Of M16A2 Rifle
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## ***Optical Sights For Light Weapons***

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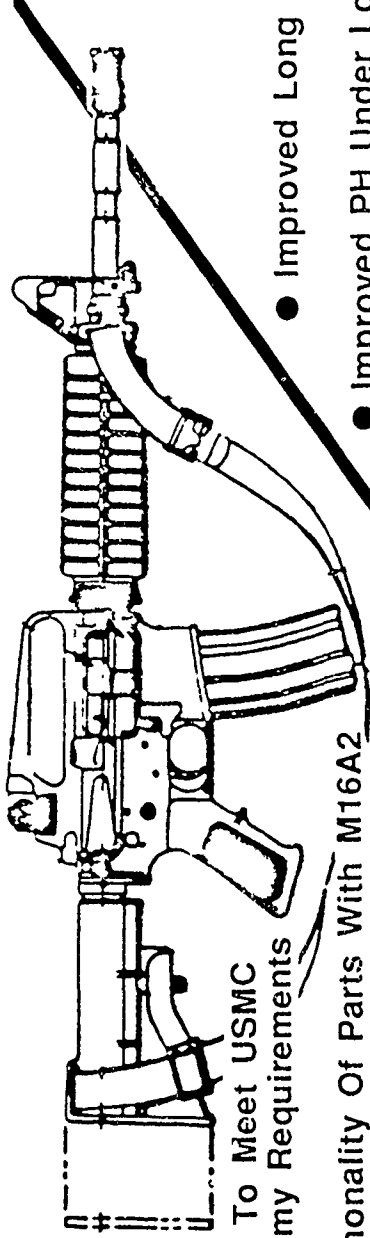
# Small Arms Master Plan

## START POINT

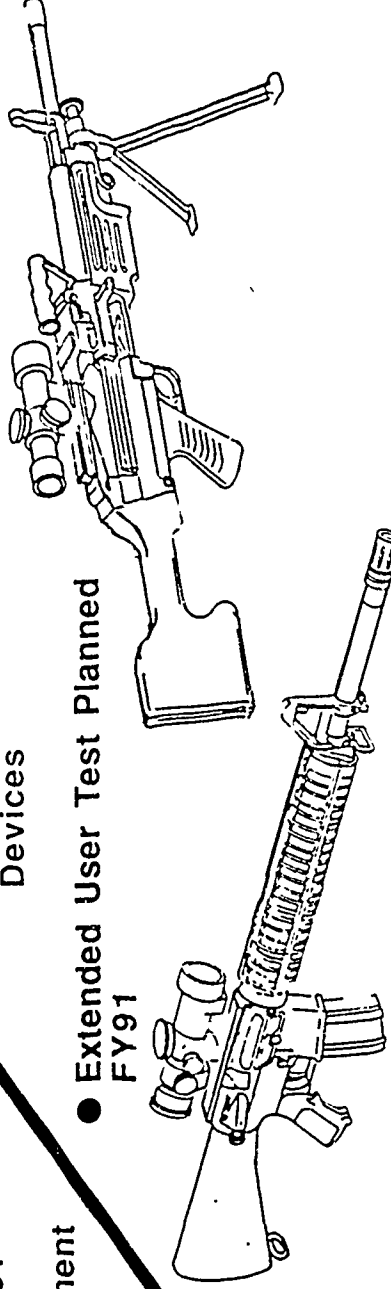
Weapon Systems	Development/Enhancement
● MK19 ● M249 ● M16A2 ● M24SWS ● M4 Carbine ● M9	● Optics ● Assault Pack ● Lightweight Materials ● Rifle Grenades ● Projectile Performance ● Lubricants ● Training Ammo

490E 23PH

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